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ABSTRACT

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international airports.

A STUDY OF
GENERAL AVIATION
AT VANCOUVER
ORD 106



Civil Aviation Branch



ABSTRACT

A preliminary air traffic study at Vancouver indicated that there was considerable inter-relatedness between the airports in the area. It was therefore decided that all the airports in the Vancouver Metropolitan area should be studied with special emphasis placed on Vancouver International Airport.

The term "general aviation" as used in this study includes all civil flying except that performed by scheduled air carriers operating large aircraft on regular routes.

A STUDY OF

GENERAL AVIATION

AT VANCOUVER

General aviation movements in the Vancouver area are expected to grow from a total of 588,472 in 1966 to 1,257,000 in 1977. This represents a 75% increase for local movements and 10.7% per annum for enroute movements, to 846,000 movements in 1972 and 1,257,000 movements in 1977.

ORD 106

The percentage of general aviation movements to total movements will increase from 41.71% in 1966 to 55.83% in 1977. Scheduled carriers will only account for 4.37% of the Vancouver area movements in 1977, compared to 5.29% in 1966 and 13.26% in 1969.

With present airport development and with the forecasted growth in total area movements, the Vancouver area airports will reach their theoretical capacity in 1971.

To avoid congestion, the present airports will require additional capacity and another airport site will be required.

In June of 1967 there were 326 general aviation aircraft based in the Vancouver area.


A general aviation survey at Vancouver International Airport carried out from June 29 to July 1, 1967 interviewed the pilots of 67% of arriving general aviation aircraft. Water arrivals constituted 28% of the aircraft.

Of the total, business arrivals made up 33%, charter arrivals 23.1%, pleasure arrivals 27.5%, training 18.0% and aerial work 8.1%.

55% of the pilots interviewed held an instrument rating.

PREPARED BY
PLANNING, RESEARCH AND DEVELOPMENT DIVISION
CIVIL AVIATION BRANCH

NOVEMBER 1967 Survey showed that 49.9% of the traffic arriving at Vancouver was taken off from Vancouver. During the same period the tower showed 25.1% as local traffic.



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ABSTRACT

A preliminary air traffic study at Vancouver indicated that there was considerable inter-relation between the airports in the area. It was therefore decided that all the airports in the Vancouver Metropolitan area should be studied with special emphasis placed on Vancouver International Airport.

The term "general aviation" as used in this report includes all civil flying except that performed by major scheduled air carriers operating large aircraft on scheduled service.

General aviation movements in the Vancouver area are expected to grow from a total of 522,267 in 1966, at a rate of 7% per annum for local movements and 10.7% per annum for itinerant movements, to 846,000 movements in 1972 and 1,257,000 movements in 1977.

The percentage of general aviation movements to total movements will increase from 94.71% in 1966 to 95.83% in 1977. Scheduled carriers will only conduct 4.17% of the Vancouver area movements in 1977, compared to 5.29% in 1966 and 13.26% in 1962.

With present airport development and with the forecasted growth in total area movements, the Vancouver area airports will reach their theoretical capacity in 1971.

To avoid congestion, the present airports will require additional capacity and another airport site will be required.

In June of 1967 there were 326 general aviation aircraft based in the Vancouver Area.

A general aviation survey at Vancouver International Airport carried out from June 29 to July 4, 1967 interviewed the pilots of 67% of arriving general aviation aircraft. Water arrivals constituted 28% of the aircraft.

Of the total, business arrivals made up 23%, charter arrivals 23.1%, pleasure arrivals 27.5%, training 18.0% and aerial work 8.4%.

35% of the pilots interviewed held an instrument rating.

Of the land aircraft 58% were said to be IFR equipped by their pilots. 10% of the seaplanes were said to be IFR equipped.

The survey showed that 49.9% of the traffic arriving at Vancouver had taken off from Vancouver. During the same period the tower showed 25.1% as local traffic.

The pilots of 59.9% of the aircraft gave "home base" as their reason for using Vancouver airport. "Close to town" was the reason given by 18.8%. Another 5.2% said "customs" was the reason and 6.5% gave "servicing".

A total of 83 or 15% of the aircraft required customs.

In 1966, the three major carriers based at Vancouver conducted 318 large aircraft charter flights. 178 large aircraft charters were carried out by other carriers.

The commercial general aviation operators at Vancouver have a total of 133 aircraft some of which are not permanently based at Vancouver.

By 1972 the operators expect to have 45% more aircraft, 95% more pilots and 73% more total personnel. They will require from 25% to 400% more space depending on the operator.

General aviation operations as a whole at Vancouver airport are expected to increase by 68% in 1977 and a further 60% by 1987.

The percentage of general aviation movements at Vancouver airport is expected to increase from 78% in 1966 to 81% in 1977.

In 1966 Vancouver Airport accounted for 18.8% of the general aviation movements in the Vancouver area. In 1977 it is expected to handle 18%.

These forecasts are valid only if the present system of airports are used and no unusual external influences are present. If another airport is added to the system or a policy change is made to influence specific segments of traffic to leave Vancouver airport, it would be necessary to re-compute the forecasts.

The present general aviation site at Vancouver Airport has the best potential for future development by general aviation.

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INTRODUCTION

This study was conducted to provide information on general aviation activities at the Vancouver International Airport. The information is prepared so that it may be used to provide an input for the Vancouver master plan which is now under preparation for the Aviation Systems Planning Group.

The secondary objective of the study is to develop a method whereby general aviation studies may be conducted at other Canadian airports.

The term "general aviation" as used in this report includes all civil flying except that performed by major scheduled air carriers operating large aircraft on scheduled service.

Although initially the report was to cover only Vancouver International Airport it was recognized quite early in the study that general aviation activity at Vancouver was greatly influenced by other airports in the Vancouver Metropolitan area. The scope of the study was therefore broadened to include other airports in the area but with special emphasis on Vancouver International.

General aviation flying embraces a multitude of diverse uses of aircraft. In this report these activities have been divided into five major categories; charter operations, business flying (corporate, private or government), training or instructional flying, pleasure flying and aerial work (crop dusting, pipe-line patrol, timber cruising, etc.).

The various activity groupings were defined as follows:

1. Business flying is the use of personal, corporate or chartered aircraft either directly for some business purpose or as a substitute for air carrier transportation to or from a place where business will be transacted.
2. Charter operations include transportation of passengers and cargo for hire. Whether conducted on a schedule basis or as small group pro rata charters, these movements are essentially supplemental to air carrier operations. In the United States this grouping is usually referred to as air taxi.

3. Pleasure flying includes transportation in personally owned or rented aircraft for recreational purposes, such as air touring and other vacation trips.
4. Training flying includes those flights whose primary purpose is instructional or practice and not transportation from place to place. This category constitutes primarily flights which are classified as local in tower counts.
5. Aerial Work consists primarily of nontransport operations and includes such activities as survey, search and rescue, police patrol, news coverage, aerial application, fire fighting, and supply to offshore and other remote locations.

TERMS OF REFERENCE

In connection with the master plan report for Vancouver International Airport and in accordance with the scope of work to be undertaken, develop a method and conduct a study to determine the following:

1. Present and anticipated aircraft mix for general aviation at Vancouver.
2. Present and potential general aviation activity.
3. The effect on airport concepts of new or existing airports in the vicinity.
4. The future plans and requirements of general aviation operators at this site, or whether they intend or would prefer to move to a satellite airport. Costs, type of operations, availability of satellite or potential satellite sites, and operators' preferences must all be considered.
5. Utilizing forecasts and optimum layout, indicate recommended areas for general aviation ground installations.

METHOD OF STUDY

The terms of reference for the study were developed from the CRP report "Scope of Work to Develop a Master Plan Report."

Statistical information was obtained from the Aviation Statistics Center. Unfortunately one of the main problems in forecasting general aviation activity is the lack of adequate historical data permitting the differentiation of non-carrier operations by type of activity. To obtain the necessary information on general aviation aircraft type of activity at Vancouver a survey was carried out from June 29 - July 4, 1967. Pilots of general aviation aircraft arriving at Vancouver airport during the survey period were asked to complete a questionnaire. A sample copy of the questionnaire is shown as Annex 1 to Appendix A.

During the same period, general aviation operators at Vancouver were asked to complete a questionnaire to determine their present activities and their future plans. This sample questionnaire is shown as Annex 2 to Appendix A.

The data obtained from the questionnaire was reduced and analyzed and was used as the basis for forecasting general aviation activity at Vancouver airport itself.

Airport and runway capacity estimates for Vancouver area airports were prepared in ORD using formulae developed by A.I.L. Limited. (Appendix B)

Two publications prepared for the Federal Aviation Agency in the United States were used as reference material; "Methodology and Criteria for National Airport Planning", Southern California Laboratories of Stanford Research Institute; "General Aviation, A Study and Forecast of the Fleet and its Use in 1975", Office of Policy Development, Federal Aviation Agency.

Talks were held with the President of the British Columbia Aviation Council and the Executive Director of the British Columbia Lower Mainland Regional Planning Board.

Visits were made to various airports in the area. Included were Pitt Meadows, Abbotsford, Langley and Delta. Airport Managers and operators based at the airports were interviewed.

PRESENT GENERAL AVIATION ACTIVITY

VANCOUVER METROPOLITAN AREA

General aviation traffic at Vancouver International diminished steadily from 1960 until 1965. This was due to two major factors:

1. Local training was discouraged at Vancouver.
2. Pitt Meadows Airport was opened for local training.

A projection of past trends of aircraft movements at Vancouver would indicate a decrease in traffic for the future. It would also indicate that Vancouver was running counter to all established aviation trends. In an attempt to reconcile this inconsistency, data was gathered for other airports in the area, i.e. Abbotsford, Pitt Meadows and Langley (see Table I). When a combined total was developed it showed a spectacular growth rate for general aviation in the Vancouver area. The increase in movements for 1966 alone was close to 70%. Since 1962 the number of aircraft movements in the area has tripled.

It became obvious that Vancouver Airport could not be studied entirely on its own, but must be considered within the context of the Vancouver Metropolitan area airports.

A study of the FAA document "Methodology and Criteria For National Airport Planning" indicated that the Stanford Research Institute had reached similar conclusions in its study of Metropolitan areas.

The local and itinerant general aviation movements for the Vancouver Metropolitan Area for 1966 are shown on Table 2. In addition, the general aviation movements which occurred during the survey period of June 29 - July 4, 1967 are shown on the same Table. No statistical figures are available for Langley airport. The figures shown are based on estimates made by the airport operator.

The percentages for each segment are relatively similar. The large increase in itinerant movements at Pitt Meadows could likely be accounted for in the change of statistical collection since the tower operation was started in the spring of 1967.

VANCOUVER METROPOLITAN AREA MOVEMENTS

Aircraft Movements	General Av. Movements	General Av. Local	Total
Abbotsford			
1966	43,540	106,974	150,514
65	25,192	52,872	78,064
64	18,698	38,315	57,013
63	11,992	35,201	47,193
62	7,256	26,000	33,256
Vancouver			
1966	77,782	20,586	98,368
65	58,769	11,643	70,412
64	50,372	10,658	61,030
63	47,492	64,951	112,443
62	42,598	86,371	128,969
Pitt Meadows			
1966	14,885	138,500	153,385
65	6,837	72,623	79,460
64	4,590	60,038	64,628
63	1,273	23,093	24,366
Langley (EST)			
1966	12,000	108,000	120,000
65	8,600	76,000	84,600
64	5,000	44,000	49,000
63	1,330	12,000	13,330
Vancouver Complex			
1966	148,207	374,060	522,267
65	99,398	213,138	312,536
64	78,660	153,011	231,671
63	62,087	135,245	197,332
62	49,854	112,371	162,225

TABLE I

GENERAL AVIATION MOVEMENTS - VANCOUVER METROPOLITAN AREA

1966

	Abbotsford	Langley	Pitt Meadows	Vancouver
No. of Local	106,974	108,000*	138,500	20,586
% of Total Local	28.6%	28.9%	37.0%	5.5%
No. of Itinerant	43,540	12,000*	14,885	77,782
% of Total Itin.	29.4%	8.1%	10.0%	52.5%
Total G.A. Move- ments	150,514	120,000*	153,385	98,368
% of Total G.A.	28.8%	23.0%	29.4%	18.8%
1966 Area Totals	Local 374,060 (72%) Itinerant 148,207 (28%) Total 522,267			

DURING SURVEY PERIOD JUNE 29 - JULY 4, 1967

No. of Local	1,386	1,400*	2,263	594
% of Total Local	24.5%	24.8%	40.1%	10.5%
No. of Itinerant	869	250*	1,327	2,682
% of Total Itin.	16.9%	4.8%	25.8%	52.3%
Total G.A. Move- ments	2,255	1,650*	3,590	3,276
% of Total G.A.	20.9%	15.3%	33.3%	30.4%
Survey Totals	Local 5,643 (52%) Itinerant 5,128 (48%) Total 10,771			

* Estimated

TABLE 2

In June of 1967 there were 326 general aviation aircraft based in the Vancouver area. The breakdown by airport is as follows:

Vancouver International	105
Abbotsford	60
Pitt Meadows	80
Langley	31
Delta Air Park	<u>50</u>
	326

FORECAST OF GENERAL AVIATION ACTIVITY

VANCOUVER METROPOLITAN AREA

The Stanford Research Institute has developed a mathematical model to forecast traffic on an area basis.

The model was developed on the premise that general aviation activity is a large non-homogeneous class of aircraft operations which are not restricted to any one airport in an area but will use those which best meet their particular requirements. Therefore, forecasting should be done on a regional basis where all interrelated airports near a metropolitan complex are included. Separate forecasts should also be made of the different segments of the general aviation population.

THE STANFORD RESEARCH INSTITUTE METHOD

A summary of the Stanford Research Institutes' "Recommended Method for Forecasting Non-carrier Activity" from their report - "Methodology and Criteria for National Airport Planning" is given below. In this method historical economic growth and general aviation growth over a ten year period are related by a "K" factor which is then used to relate general aviation growth in the future to predicted economic growth.

The economic growth of the area is assessed by considering the trends in such factors as, population, employment categories and their related income levels, and total area income. In the forecasting of non-carrier traffic or aircraft movements it is considered essential that any employment and income forecasts developed apply to the appropriate airport planning area - the metropolitan area.

GENERAL

1. An entire metropolitan complex should be treated as a single planning area.
2. A ten year growth period is recommended.

METHOD

1. Collect historical data for each type of non-carrier activity.
2. Calculate the historical growth factor (T_f)

$$T_f = \frac{T_2}{T_1}$$

3. Collect historical employment and income data
4. Calculate the economic growth factor (I_f)

$$I_f = \frac{I_2}{I_1}$$

where

$$I_2 = \sum_{i=1}^n E_i (MI)_i = \text{total income in the planning area in a recent year.}$$

$$\text{and } I_1 = \sum_{i=1}^n E_i (MI)_i = \text{total income in the planning area of, say, ten years ago.}$$

5. Calculate the "K" factor

$$K = \frac{T_f}{I_f}$$

6. If "K" factor differs greatly from Unity (1) other factors besides economic would have to be considered. This may be the case in pleasure itinerant and non-scheduled charter.
7. Project the economic figures.
8. Find the future economic growth factor I_f

$$I_f = \frac{I_2}{I_1}$$

where I_2 = projected total income in the last year of the growth period (i.e. 10th year)

I_1 = projected total income in a base year (i.e. present year)

9. Find the growth factor T_f

$$T_f = I_f K$$

10. Calculate the projected activity for the type of non-carrier operation chosen- T_2

$$T_2 = T_1 T_f$$

where

- n is the number of employment categories used in analyzing the business and industrial activity in the planning area
- E_i is the projected number of employees in the i^{th} area employment category in a specified future year
- $(MI)_i$ is the median income per employee in the i^{th} area employment category in a specified future year
- I_2 is the total income in the planning area in a specified future year
- I_1 is the total income in the planning area in a specified base year
- I_f is the growth factor, or ratio of area income in the specified future year to area income in the specified base year.

and where

- T_2 is the volume of traffic handled by the given type of noncarrier aircraft activity in the area in a specified future year.

or

- is the number of noncarrier aircraft operations of a given type in the area in a specified future year
- T_1 is the level of a given type of noncarrier activity (traffic or number of aircraft operations) in the area in a specified base year
- T_f is the growth factor, or ratio of the level of a given type of noncarrier activity in the area in the specified future year to the level of that activity in the specified base year
- K is a factor that takes into account the change in a given type of noncarrier activity attributed to influences other than change in area employment and income per se.

LIMITATIONS OF S.R.I. FORECAST

The S.R.I. forecast is a regional forecast and hence nothing can be said about individual airports using this method. Short term changes in activity generated by changes in policy cannot be forecast accurately by this method or any other, except one which is based on ad hoc estimates based on experience. As was pointed out, the greatest limitation is the lack of historical data. Neither the necessary economic data nor general aviation by type data are available for Canada.

ADVANTAGES OF S.R.I. FORECAST

Being a regional forecast the S.R.I. method uses a broader base than a single airport forecast would. Since the forecast is based on economic factors, long term results of the forecast would tend to be more accurate than a forecast based only the previous growth of aviation. The S.R.I. method does meet the two specifications mentioned above -- segmented forecasting and forecasting by area. Lastly it is a method that can be easily repeated to improve forecasts as new information becomes available.

MODIFIED S.R.I. METHOD USED FOR VANCOUVER AREA

It was necessary to modify the S.R.I. method for this study since the proper data was not available. The economic parameter used was total income of the area, as found in "Taxation Statistics", because a good correlation was found between total income and aviation growth and also it seemed a reasonable approximation to the economic parameter suggested by S.R.I. The only differentiation by type possible was civil local and civil itinerant, less the scheduled itinerant movement. Since no projected economic figures were available for the Vancouver area, a linear regression was made on the last five years for Total Area Income to produce a future economic figure.

FORECAST OF CIVIL LOCAL AIRCRAFT MOVEMENTS AT VANCOUVER METROPOLITAN COMPLEX USING SRI METHOD

GENERAL

1. The entire metropolitan complex (Vancouver Intl., Pitt Meadows, Langley & Abbotsford) was considered.
2. A ten year growth period was used.

METHOD

1. Historical aviation data:

	1966	1956	
Abbotsford	106974	23000	
Vancouver	20586	121205	Civil
Langley	108000	23000	Local
Pitt Meadows	138060		Movements
Total	374060	167205	

2. Historical growth factor (T'_f)

$$T'_f = \frac{T'_2}{T'_1} = \frac{374060}{167205} = 2.24$$

3. Historical economic data:

	1966	1956	
Metropolitan Vancouver	\$1.50 x 10 ⁹	\$0.817 x 10 ⁹	Total Income

4. Economic growth factor

$$I'_f = \frac{I'_2}{I'_1} = \frac{1.50}{0.817} = 1.84$$

5. "K" factor

$$K = \frac{T'_f}{I'_f} = 2.24/1.84 = 1.22$$

6. "K" factor is close enough to one.

7. Project economic figures

(Using simple linear regression on last six years of total income in Metropolitan Vancouver)

	1967	1977
Metropolitan Vancouver	\$1.50 x 10 ⁹	\$2.42 x 10 ⁹

8. Future economic growth factor

$$I_f = \frac{I_2}{I_1} = \frac{2.42}{1.50} = 1.61$$

9. Future aviation growth factor

$$T_f = I_f K = (1.61)(1.22) = 1.96$$

10. Project number of civil local aircraft movements in 1977 in Vancouver Metropolitan complex

$$\begin{aligned} T_2 &= T_1 T_f & T_1 \text{ is 1967 figure } 410,000 \\ &= (410000)(1.96) \\ &= 804000 \end{aligned}$$

$$\therefore T_2 = 804000$$

This is 7% increase per annum.

FORECAST OF CIVIL ITINERANT AIRCRAFT
MOVEMENTS AT VANCOUVER METROPOLITAN COMPLEX USING
SRI METHOD

GENERAL

1. The entire metropolitan complex (Vancouver Intl., Pitt Meadows, Langley & Abbotsford) was considered.
2. A ten year growth period was used.

METHOD

1. Historical Aviation Data:

	<u>1966</u>	<u>1956</u>	
Abbotsford	43540	2000 (est)	
Vancouver	77782	43373	
Langley	120000 (est)	2000 (est)	
Pitt Meadows	14885		
			Civil
			Itinerant
			Movements
Total	148207	47373	

2. Historical Growth Factor (T'_f)

$$T'_f = \frac{T'_2}{T'_1} = \frac{148207}{47373} = 3.13$$

3. Historical Economic Data:

	<u>1966</u>	<u>1956</u>	
Metropolitan	9	9	Total
Vancouver	\$1.50 x 10	\$0.817 x 10	Income

4. Economic Growth Factor

$$I'_f = \frac{I'_2}{I'_1} = 1.50/0.817 = 1.84$$

5. "K" Factor

$$K = \frac{T'_f}{I'_f} = \frac{3.13}{1.84} = 1.70$$

6. K Factor is close enough to one

7. Projected Economic Figures

(Using Simple Linear Regression on last six years of Total Income in Metropolitan Vancouver)

	1967	1977
Metropolitan Vancouver	\$1.50 x 10 ⁹	\$2.42 x 10 ⁹

8. Future Economic Growth Factors

$$I_f = \frac{I_2}{I_1} = \frac{2.42}{1.50} = 1.61$$

9. Future Aviation Growth Factor

$$T_f = I_f K = (1.61)(1.70) = 2.74$$

10. Projected Number of Civil Itinerant Aircraft Movements in 1977 in Metropolitan Complex of Vancouver

$$\begin{aligned} T_2 &= T_1 T_f && T_1 \text{ is 1967 Figure 163,000} \\ &&& \text{(assuming 10\% increase over 1966)} \\ &= (163000)(2.74) \\ &= 446000 \end{aligned}$$

∴ T_2 is 446000

This is 10.7% increase per annum.

Table 3 shows the results of the forecast of general aviation movements for the Vancouver Metropolitan area using the SRI method. After 1967 the forecast increases are 7% per annum for local movements and 10.7% per annum for itinerant movements.

Forecast of General Aviation Movements

<u>Vancouver Metropolitan Area</u>			
<u>Year</u>	<u>General Aviation Local</u>	<u>General Aviation Itinerant</u>	<u>General Aviation Total</u>
1966	374,060	148,207	522,267
67	410,000	163,000	573,000
72	575,000	271,000	846,000
77	806,500	450,500	1,257,000

TABLE 3

The SRI method only provides a forecast of the total area under study. Activities at particular airports are influenced by factors which do not at all depend on past activity. Factors such as policy change and introduction of new airports (as in Vancouver Region with Pitt Meadows) affect activity in such a way that they can be forecast only by heuristic methods employed by experienced and knowledgeable forecasters.

The ratio of general aviation traffic to the total Vancouver Metropolitan area traffic has been steadily growing, while the ratio of scheduled carrier traffic has been decreasing. This trend is expected to continue in the future. As can be seen from Table 4, in 1977 general aviation will constitute 95.83% of the Vancouver area movements.

VANCOUVER METROPOLITAN AREA

RATIO OF GEN. AVIATION MOVEMENTS AND SCHEDULED

MOVEMENTS TO AREA MOVEMENTS

	<u>Gen. Av.</u>	<u>%</u>	<u>Sched.</u>	<u>%</u>	<u>Total</u>
1962	162,225	86.74	24,804	13.26	187,029
1963	197,332	88.56	25,509	11.44	222,841
1964	231,671	90.78	23,557	9.22	255,228
1965	312,536	92.24	26,298	7.76	338,834
1966	522,267	94.71	29,180	5.29	551,447

FORECAST

1967	573,000	94.42	32,000	5.58	605,062
1972	846,000	95.18	42,900	4.82	888,900
1977	1,257,000	95.83	54,700	4.17	1,311,700

TABLE 4

AIRCRAFT MOVEMENTS IN VANCOUVER AREA

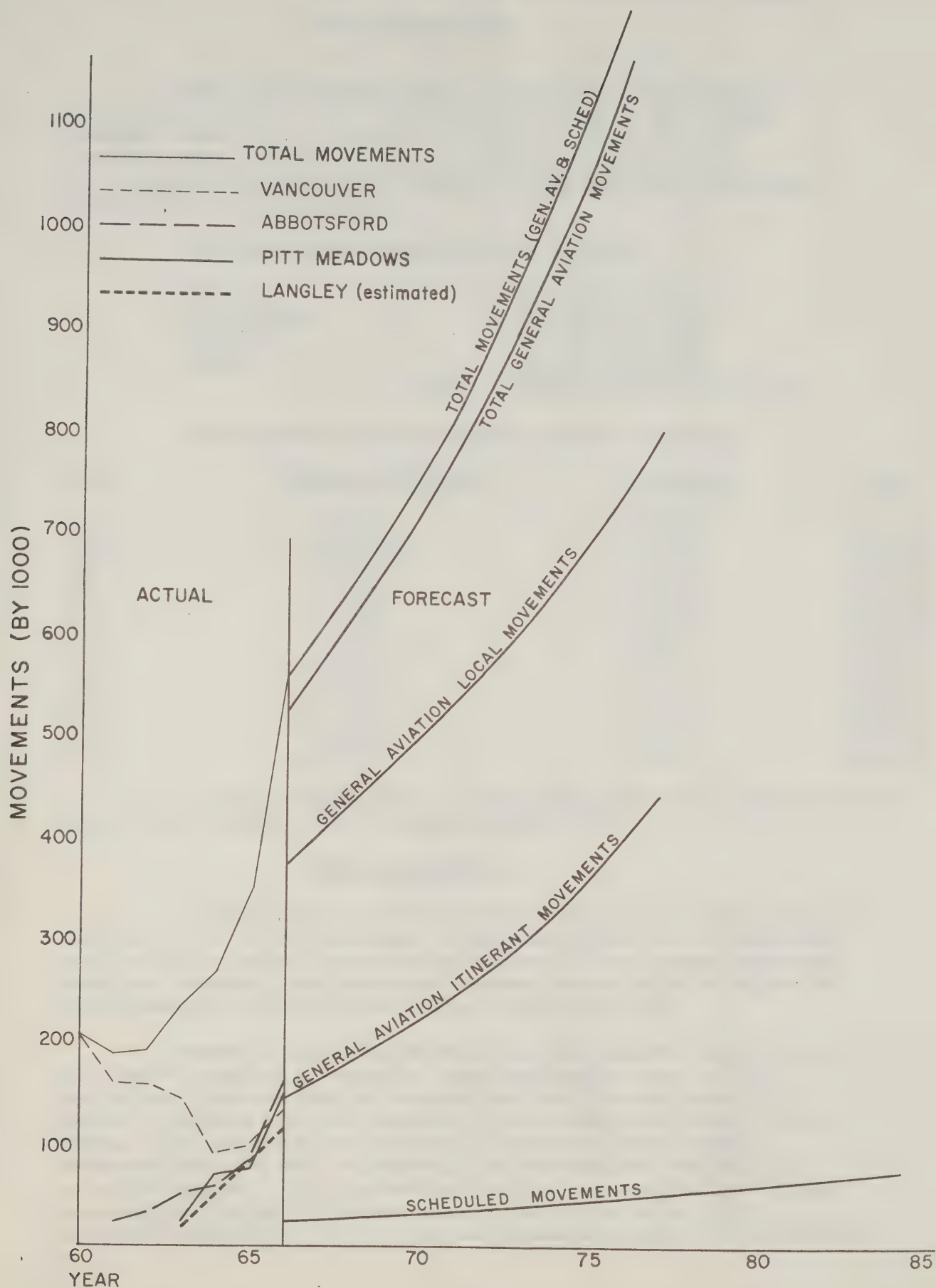


FIGURE I

AIRPORT CAPACITIES

Annual theoretical capacities were calculated for each of the area airports. The capacities were based on an average peak hour delay of four minutes for departing aircraft, the present runway layouts and present aircraft population mixes. The techniques recommended by the FAA and the AIL were used in the computations. (See Appendix B).

The annual capacities are estimated to be:

Vancouver	238,400 movements
Pitt Meadows	178,000 movements
Abbotsford	183,700 movements
Langley	165,000 movements
TOTAL	765,100 movements per year.

The forecasted annual movements for the area are:

<u>Year</u>	<u>General Aviation</u>	<u>Scheduled</u>	<u>Total</u>
1967	573,000	32,062	605,062
1968	619,100	35,268	654,368
1969	669,000	37,031	706,031
1970	723,400	38,882	762,282
1971	782,200	40,826	823,026
1972	846,000	42,900	888,900
1973	915,300	45,010	960,310
1974	990,400	47,260	1,037,660
1975	1,072,000	49,623	1,121,623
1976	1,160,700	52,104	1,212,804
1977	1,257,000	54,709	1,311,709

At the forecasted rate of growth the theoretical capacity of the present area airports will be reached before 1972.

AREA REQUIREMENTS

To cope with the traffic growth the capacity of the area airports will have to be increased. The great majority of the increased traffic will be general aviation and so even if the present area airports are improved, the forecasted increase in activity indicates the requirement for an additional general aviation airport.

Present thinking on metropolitan area airports tends toward the idea of a system of airports, each performing a more or less specialized function such as international and domestic scheduled service, business aircraft operations, and training or instructional flying. The Vancouver area is ideally suited to this concept. Vancouver International is presently an international and domestic scheduled airport. Pitt Meadows and Langley are essentially training airports and Abbotsford is available in the future as a second scheduled airport for Vancouver as the population centre shifts eastward.

The type of airport which will be required is one which caters primarily to business operations. The prime requirements for this type of airport are ease of access and adequate facilities.

A study of the Vancouver area quickly indicates that the best location for an airport of this type would be at the present Boundary Bay Airport site. The airport is less than five minutes further from the Vancouver Oak Street bridge than the present Vancouver Airport terminal. The site is available shortly and runway development costs would be much less than at a new site. Some navigation facilities and buildings would be required. An ILS at Boundary Bay would relieve the simulated approach operations at Vancouver. The municipality of Delta and the B.C. Aviation Council have been pressing for an airport development at Boundary Bay.

The principal objection to this airport in the past has been due to the difficulties of separating arriving and departing traffic at Vancouver International from aircraft operating from Boundary Bay. With the installation of radar control at Vancouver and changes in operating techniques, it is now possible to solve the problem.

PRESENT GENERAL AVIATION ACTIVITY

VANCOUVER INTERNATIONAL AIRPORT

Vancouver airport is unusual among major international airports since it has a large number of fixed-base operators and a high proportion of water operations.

Operations conducted at Vancouver cover the entire range of civil aviation activity from the large trans-oceanic jet to the small single-engine seaplane and helicopters.

Any study carried out at Vancouver must recognize the existence of all these varied activities.

Little if any historic data is available for General Aviation operations at Vancouver. To obtain usable data for planning and forecasting purposes a six day survey was carried out. The survey's main objective was to classify general aviation into five classifications by use of aircraft. The definition of these classes are given in the introduction to this report. Other additional information such as IFR capabilities of both pilot and aircraft, points of departure, reasons for using Vancouver airport and number of aircraft requiring customs, was gathered at the same time.

The survey took place from June 29 to July 4, 1967 inclusive, from 0700 to 2200 hours each day. Survey personnel were placed at various points on the airport usually frequented by general aviation aircraft. An attempt was made to interview the pilot of each arriving aircraft. In general the reception by the pilots was excellent although some questioned the requirement for being interviewed more than one time especially if they were making shuttle flights.

In comparing the tower arrival reports with the aircraft surveyed it was found that 67% of the arrivals had been surveyed. The remainder were missed for various reasons; arriving outside the survey period approximately 10%; aircraft arriving in a given area in groups with the surveyor unable to cover them all, about 10%; aircraft arriving at locations on the airport not covered by survey personnel, about 10%.

The results of the survey by aircraft use are shown in Table 5. Water arrivals accounted for 28% of the surveyed aircraft. Almost half of these were charter water arrivals, 13.8% of the total.

VANCOUVER INTERNATIONAL AIRPORT

	Thursday June 29	Friday June 30	Saturday July 1	Sunday July 2	Monday July 3	Tuesday July 4	Total	%
Total Movements	590	571	602	477	520	516	3276	
Gen. Av. Movements	451	423	418	336	363	374	2365	72
Gen. Av. Arrs.	151	166	137	105	137	121	817	
Surveyed Arrivals	99	117	85	75	100	73	549	67
SURVEY RESULTS								
Land Arrivals	72	88	62	56	78	40	396	72
Water Arrivals	27	29	23	19	22	33	153	28
Business Arrivals								
Water	10	5	3	4	8	11	41	7.5
Land	22	25	8	8	13	9	85	15.5
Total	32	30	11	12	21	20	126	23
Charter Arrivals								
Water	13	14	14	9	10	16	76	13.8
Land	7	9	7	11	12	5	51	9.3
Total	20	23	21	20	22	21	127	23.1
Pleasure Arrivals								
Water		4	4	4	1	2	15	2.7
Land	16	27	26	24	32	11	136	24.8
Total	16	31	30	28	33	13	151	27.5
Training Arrivals								
Water			1		1	1	3	.5
Land	17	19	18	12	18	12	96	17.5
Total	17	19	19	12	19	13	99	18.0
Aerial Work								
Water	4	6	1	2	2	3	18	3.3
Land	10	8	3	1	3	3	28	5.1
Total	14	14	4	3	5	6	46	8.4

TABLE 5

SOURCE: ORD SURVEY

PERCENTAGE DAILY GENERAL AVIATION BY USE DURING SURVEY PERIOD JUNE 29 - JULY 4

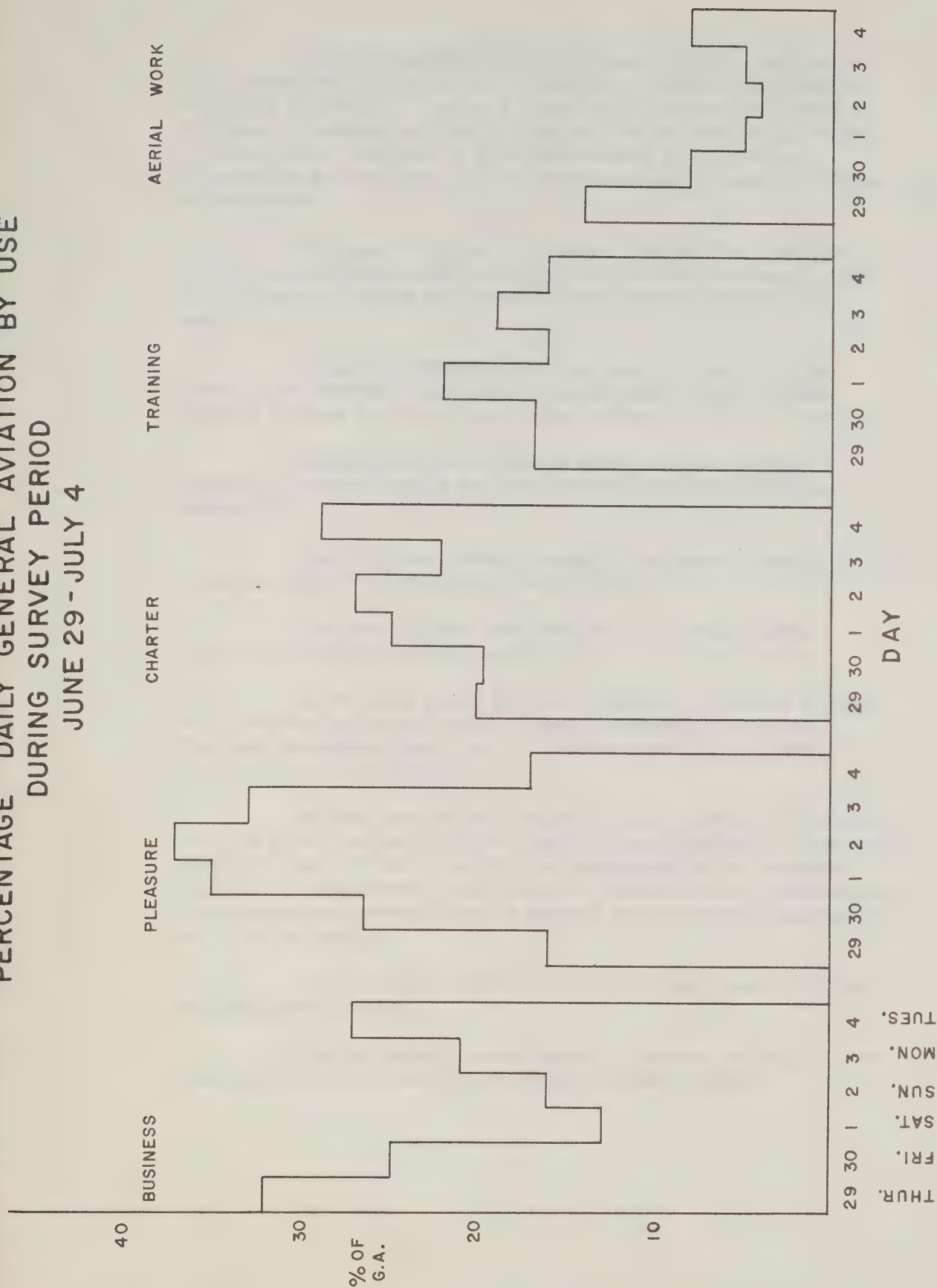


FIGURE 2

Pleasure arrivals (27.5%) and training arrivals (18%) account for nearly half (45.5%) of the total general aviation arrivals. Figure 2 shows the aircraft arrivals by class of operation and indicates the pattern which might be expected. That is, a high percentage of business flights on weekday and a high percentage of pleasure flights on weekends.

Business flights (30) were high on Thursday and Friday, but dropped off, sharply (12) on the weekend. From mid afternoon Monday business flights began to pick up again.

Pleasure however, was the exact opposite going from a low Thursday (16) to a steady peak (28-33) Friday through Monday and again declining sharply (13) on Tuesday.

Aerial work went from a peak on Thursday and Friday (14) dropping to minimal proportion from Saturday onward (5).

Training was steady through the survey period (19) dropping only on Sunday and Tuesday (12)

Charter flights remained at a constant level through the entire survey period (21).

Since this was a holiday weekend, business flights were low on Saturday through Monday, however, the high pleasure movements kept the G.A. movements fairly constant during the survey period.

During the entire period of the survey the weather was VFR with the ceiling and visibility unlimited. From this point of view it could hardly be considered to be weather typical of Vancouver's reputation. Nevertheless, the weather did enable the survey team to gather a much larger sample of arriving aircraft.

Of the total number of pilots interviewed 35% held an instrument rating.

The following percentages of general aviation aircraft were said to be IFR equipped by their pilots.

PERCENTAGE OF GENERAL AVIATION

AIRCRAFT IFR EQUIPPED

<u>USE</u>	<u>LAND</u>	<u>SEA</u>	<u>TOTAL</u>
Pleasure	63%	13%	55%
Business	59%	5%	41%
Charter	67%	12%	34%

Very few training or aerial work aircraft were IFR equipped so that their numbers are not significant except to reduce the total percentages.

TOTAL	58%	10%	45%
-------	-----	-----	-----

An attempt was made to relate local flights as reported by the Vancouver tower to the flights which gave Vancouver as the point of departure on the questionnaire. This was completely unsuccessful and points up the difficulties which are encountered in trying to use what little statistical information that is available. Of the 2365 general aviation movements reported by the tower, 594 or 25.1% were counted as local.

The survey showed that 49.9% of the aircraft arriving at Vancouver had taken off from Vancouver.

This is broken down as follows:

	<u>Point of Departure - Other Than Vancouver</u>		<u>Point of Departure - Vancouver</u>	
	<u>No.</u>	<u>% of Total</u>	<u>No.</u>	<u>% of Total</u>
Thursday June 29	45	45%	55	55%
Friday June 30	69	59%	48	41%
Saturday July 1	42	49.4%	43	50.6%
Sunday July 2	41	54.7%	34	45.3%
Monday July 3	38	38%	63	62%
Tuesday July 4	38	54.4%	32	45.6%
AVERAGE		50.1%		49.9%

The discrepancy is no doubt due to the definition of local flights. The tower definition is that a local flight is "One in which the aircraft remains at all times under tower control."

The tower defines an Itinerant Movement as "One in which the aircraft enters or leaves tower control."

It is obvious that a third of the flights which the tower had classed as itinerant had actually departed from and arrived at Vancouver although it is probable they had left the Vancouver tower control. This fact should be kept in mind when assessing tower movement statistics.

Question 9 on the questionnaire attempted to discover the reason why general aviation aircraft landed at Vancouver airport. The following shows the breakdown of the replies:

<u>Reason For Using Vancouver</u>	<u>No. of Replies</u>	<u>Percentage</u>
(a) Close to town	102	18.8%
(b) Meet Scheduled Airline	14	2.6%
(c) Aircraft Servicing	36	6.5%
(d) Weather	0	0%
(e) Other	38	7.0%
(f) Home Base (Incl. all Training)	325	59.9%
(g) Customs	28	5.2%

It is interesting to note that while 83 aircraft or 15% of the aircraft landing at Vancouver required customs, only 5.2% gave customs as a reason for coming to Vancouver. The Vancouver airport customs office reported the following customs clearances during the survey period:

1. Charter Flights Trans Ocean in (Form AG-1)	4
2. Charter Flights Trans Border in (Form AG-1)	11
3. U.S. Aircraft in on Cruising Permits (C.12)	65
5. Can. Aircraft in on Cruising Permits (C.12)	12
TOTAL	92

MONTHLY AIRCRAFT MOVEMENTS AT VANCOUVER AIRPORT

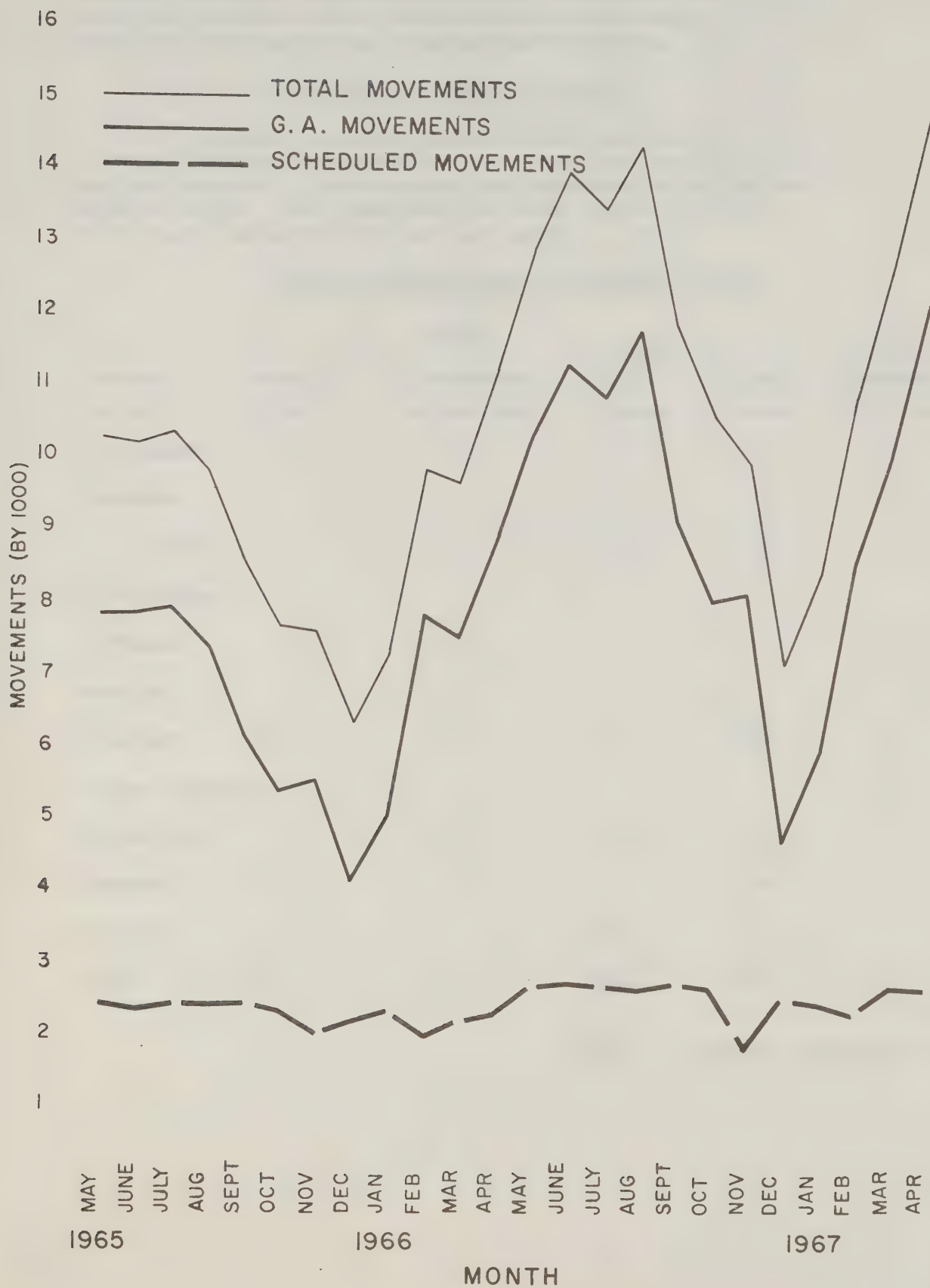


FIGURE 3

It will be seen from Figure 3 that scheduled aircraft movements are fairly constant throughout the year but general aviation tends to peak in the summer months and drop appreciably in the winter months.

LARGE AIRCRAFT CHARTER FLIGHTS

In 1966, according to available figures, 496 charter flights were conducted to or from Vancouver International Airport. Table 6 shows the breakdown by carrier and type of flight. For comparison the total figures for the first three months of 1967 are also shown.

VANCOUVER INTERNATIONAL - CHARTER FLIGHTS

Carrier	Domestic	<u>1966</u>		Other Intl.	Total	<u>1967</u>
		Transborder				January February March
Air Canada	10	5		4	19	13
Schreiner				27	27	3
Can. Pacific	60	10		28	98	15
Flying Tiger						4
Lufthansa						4
Nordair						6
P.Western	150	29		32	211	46
United Airlines						2
Martin Air				53	53	
Transair	25	1			26	
Wardair	2			60	62	
TOTAL	247	45		204	496	93

SOURCE: Aviation Statistics Center

TABLE 6

In 1966, the three major carriers based at Vancouver conducted 318 charter flights. These flights would normally use the facilities already available at the airport for their scheduled services, e.g. gate positions, ticket counters, baggage handling equipment, personnel, office space. The remainder of the charter flights, 178, are what might be called transient charters. These flights require much the same handling facilities as scheduled aircraft. Unless equivalent facilities are provided for them elsewhere on the airport it will be necessary to accomodate them at the terminal building.

GENERAL AVIATION OPERATORS SURVEY

VANCOUVER INTERNATIONAL AIRPORT

Nine major aircraft operators are based at Vancouver airport. Three of these, Canadian Pacific Airlines, Pacific Western Airlines and Air Canada are scheduled carriers operating large aircraft and therefore do not fall within the terms of reference of this study. Two other scheduled carriers, B.C. Airlines and Airwest, are covered by the study.

Staron Flight, West Coast Air Services and Harrison Airways are charter and training organizations who at first glance appear to be competitive but upon deeper study are found to be developing along more complementary lines. West Coast Air Services are mainly a seaplane charter organization with some land charter and training flying. Staron Flight is presently mainly a training and land and sea charter operation but is concentrating its future development on an IFR executive charter service. Harrison Airways is concentrating on providing an air taxi business which would supplement the scheduled carriers' service.

Charter/Air Taxi operations may be categorized as transport operations that permit air access to points not economically justifying inclusion on air carrier schedules, and that provide access to carrier-served points at times when air carrier service is not available.

Charter operations therefore serve essentially the same types of traffic as do air carriers, frequently as part of the same air trip, and normally require access to air carrier airports and terminal facilities for purposes of connecting with scheduled flights.

Okanogan Helicopters is reputed to be the world's largest civil helicopter operator, however most of its flying operations are conducted away from Vancouver.

There are three or four minor flying companies with one or two aircraft who are difficult to contact and were not interviewed.

Therefore, six Vancouver based firms were interviewed:

B.C. Airlines, Ltd.

Airwest Airlines, Ltd.

Harrison Airways, Ltd.

Staron Flight, Ltd.

West Coast Air Services

Okanogan Helicopters, Ltd.

These operators between them have a total of 133 aircraft, not all of which are permanently based in Vancouver.

The aircraft break down into the following groups:

Type	Wheels	Floats	Amph.
Single eng 0-5000 lbs.	16	27	
Single eng 5001-15000 lbs.		18	
Multi-eng. 0-5000 lbs.	5		2
" " 5000-15000 lbs.	2		6
Helicopters 0-5000 lbs.	47		
" 5000-15000 lbs.	9		

In 1972 they forecast a total of 193 aircraft or an increase of 45%.

In 1966 these companies employed a total of 409 people compared to 322 in 1961, an increase of 24%. Of these employees 138 were pilots, compared to a total of 96 pilots in 1961 or an increase of 43%.

The forecast by the operators for their 1972 personnel requirements is 711 total personnel, an increase of 73% and 260 pilots, an increase of 95%.

In 1966 these companies flew a total of 74,442 hours and carried 122,635 passengers or approximately 10% of the total passengers carried by scheduled carriers at the Vancouver Airport.

All operators were satisfied with their present location although Staron Flight required more outside tie-down space and B.C. Airlines required more hangar space.

Okanogan Helicopters reported that a car park had been build on their previous aircraft parking area.

Harrison Airways a charter/air taxi operator, reported that he was unable to obtain counter space in the arrivals lobby of the new terminal building although four automobile U-Drives were able to secure 15 feet of counter space each or 60 feet out of the total of 75 feet available. B.C. Airlines was the only General Aviation operator with space in the new terminal.

Airwest and Okanogan both felt that their present area would be adequate for 1972 although Okanogan will require 25% more tie-down space. B.C. Airlines, Harrison Airways and West Coast Air Services all will require double their present hangar space by 1972. Staron Flight estimate they will require four times their present space by 1972, both hangar and outside tie-down.

Staron and Harrison both had a requirement for General Aviation terminal facilities and both operators were interested in running a charter handling service, e.g. aircraft handling, ramp equipment, fuel, terminal facilities for passenger handling. There were over a dozen large aircraft charter flights arriving at Vancouver during the period the survey team was there. The charter handling facilities are definitely inadequate at present and it was reported that the airport management discourages local operators from providing better service.

There were other reports that fuel was difficult if not impossible to obtain between the hours of 2200 - 0700 local.

Harrison Airways reported that it was difficult to obtain mortgage money for construction of new hangars since it was only possible to obtain 20 year leases on airport property.

VANCOUVER INTERNATIONAL AIRPORT
POTENTIAL GENERAL AVIATION ACTIVITY

Two publications were used as references in preparing the general aviation forecasts for Vancouver: "Methodology and Criteria for National Airport Planning" prepared for the FAA by the Southern California Laboratories of Stanford Research Institute and "General Aviation, A Study and Forecast of the Fleet and its Use in 1975", by the Office of Policy Development, Federal Aviation Agency.

The Stanford study recommended that each segment of general aviation be forecast separately to enable a total forecast to be made. This recommendation was used as it appeared the most practical way to approach the problem. The FAA general aviation forecast increases for each related segment were used as a guide, with a factor applied for the peculiarities of the Vancouver operations.

The FAA forecasts were only for a ten-year period, therefore the twenty-year forecasts were compiled by using a projection of the forecast increases for ten years together with an estimate of the general trends in general aviation at Vancouver.

Since there was no specific forecasting technique available for the water segment of the general aviation activities at Vancouver, a study of operators' opinions and likely trends led to the general assumption that water operations would increase at a much lower rate than land operations for the first ten-year period and would likely decrease for the second ten-year period. This was expected to result from the development of economical VTOL aircraft which would replace seaplane operations in areas where airports could not be constructed.

This was enhanced by the fact that the general aviation operators of this type of aircraft reported that approximately 60 percent of their operations were within 100 miles of Vancouver and 95 percent of their operations were within 500 miles. This would likely be within the cruising range of an improved VTOL aircraft.

Another factor to be considered is that the improvement of water facilities at Pitt Meadows would likely draw some of the pleasure and training activities to that base.

The Vancouver Airport general aviation forecasts are shown in Table 7 .

VANCOUVER INTERNATIONAL AIRPORT

GENERAL AVIATION FORECAST

	1967			1977			1987	
	Number	% Total		Inc. Number	% Total		Inc. Number	% Total
Land								
Arrivals	396	72%	86%	744	80%	81%	1350	90%
Water								
Arrivals	153	28%	22%	187	20%	-23%	142	10%
	549		68%	931		60%	1492	
Business								
Arrivals								
Water	41	7.5%	25%	52	5.6%	-20%	42	2.8%
Land	85	15.5%	50%	128	13.7%	60%	205	13.7%
Total	126	23%	43%	180	19.3%	37%	247	16.5%
Charter								
Arrivals								
Water	76	13.8%	5%	80	8.6%	-50%	40	2.8%
Land	51	9.3%	150%	125	13.4%	100%	250	16.8%
Total	127	23.1%	61%	205	22%	41%	290	19.6%
Pleasure								
Arrivals								
Water	15	2.7%	66%	25	2.7%	0%	25	1.7%
Land	139	24.8%	80%	251	27.0%	75%	439	29.4%
Total	154	27.5%	79%	276	29.7%	64%	464	31.1%
Training								
Arrivals								
Water	3	.5%	66%	5	.5%	0%	5	.3%
Land	93	17.5%	115%	200	21.5%	100%	400	26.8%
Total	96	18.0%	113%	205	22%	97%	405	27.1%
Aerial Work								
Arrivals								
Water	18	3.3%	39%	25	2.7%	20%	30	2.0%
Land	28	5.1%	42%	40	4.3%	40%	56	3.8%
Total	46	8.4%	41%	65	7.0%	32%	86	5.8%

TABLE 7

VANCOUVER INTERNATIONAL AIRPORT
GENERAL AVIATION FORECAST FOR LAND AIRCRAFT

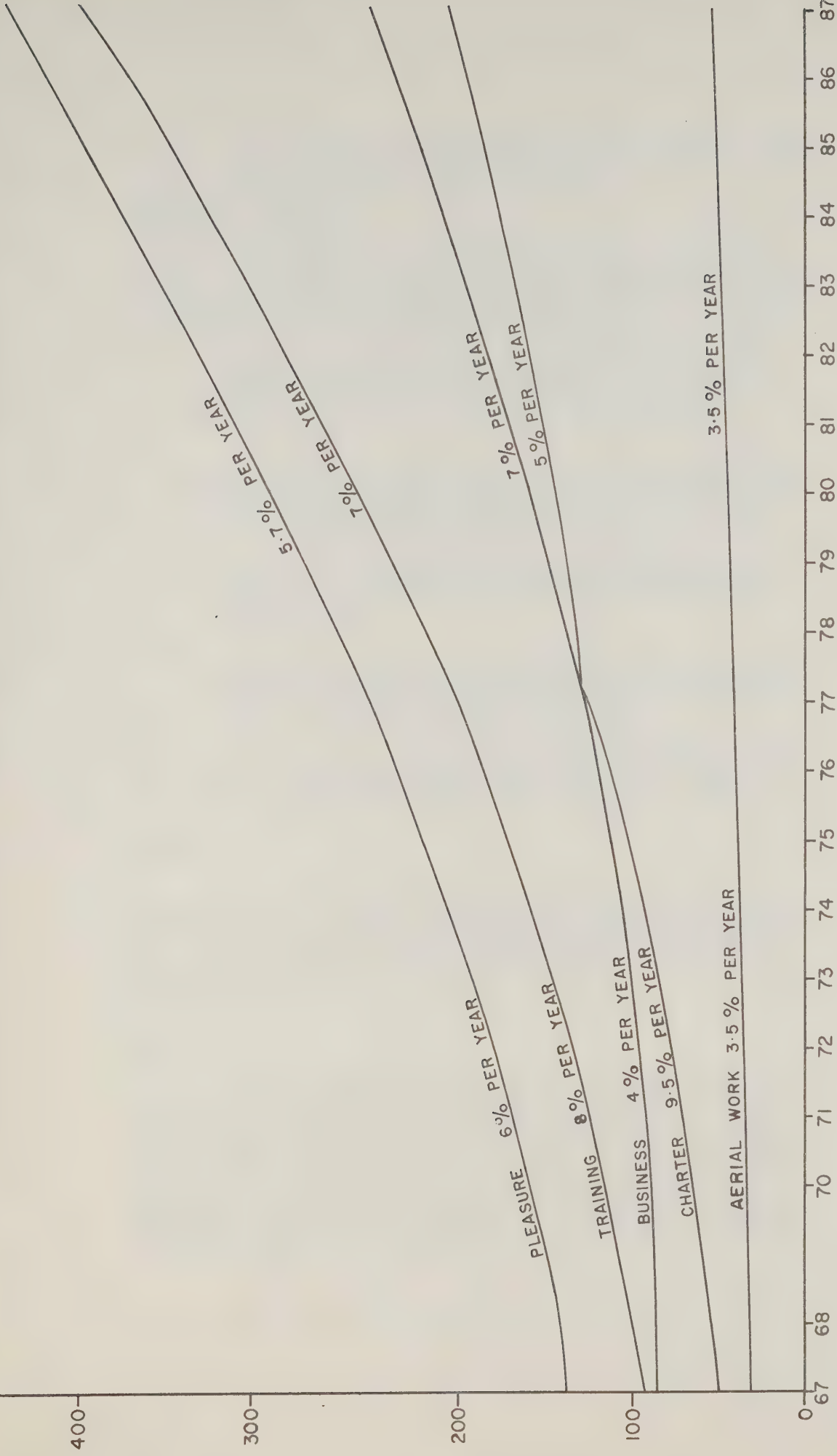


FIGURE 4

The reasoning behind the forecasts shown in Table 7 for the various segments are as follows:

BUSINESS OPERATIONS

The Vancouver area has, for a city of its size, a relatively small business/corporate aircraft fleet. This is probably due to the following factors:

1. There are few head offices of business firms in Vancouver, most are branch offices. Corporate aircraft are as a rule usually kept for head office use.
2. The mountains to the east are a natural barrier for the type of aircraft presently used for this type of operation in other areas of Canada.
3. Many of the settlements on the coast and in the interior do not have airports and are served by seaplanes only.
4. The type of aircraft most suitable for the area would be an IFR-equipped, pressurized amphibian of which there are none available at this time.
5. There is good airline service from Vancouver to the major cities where most businessmen go. There is good charter service to other areas.

Water

It was felt that the seaplane business fleet at Vancouver would increase slowly for ten years for a total rate of 25 percent, and then would decrease 20 percent for the next ten years with new airports opening and better VTOL aircraft.

Land

Since pressurized, light twin aircraft are now becoming available, it is expected that there will be an increase in land business aircraft but not likely at the 52.5 percent rate forecast by FAA. The forecast increase for the first ten years is 50 percent. As equipment more suited to the particular problems at Vancouver becomes available, the second ten year period would likely show an increased growth rate of 60 percent.

CHARTER OPERATIONS

Water

The general aviation seaplane operators do not expect a large growth in water traffic and there is a slight trend to wheel operations. It is therefore expected there would be a small increase of 5 percent for the first ten years and a decrease of 50 percent in the second ten years.

Land

The FAA forecast an increase of 155.7 percent of this type of activity for ten years. The Vancouver activity is expected to follow this trend closely and an increase of 150 percent is forecast for the first ten years. This rate of increase is not likely to be sustained, therefore an increase of 100 percent is forecast for the second ten-year period.

PLEASURE OPERATIONS

Pleasure flying at Vancouver is apparently the largest segment of general aviation activity although facilities are minimal for this type of operation. Almost two-thirds of this traffic was itinerant and the majority of these were United States registered. These had come to Vancouver International since it was a customs port of entry.

Water

While pleasure operations presently constitute only 10 percent of water operations at Vancouver, it is expected that this will increase by 66 percent to 13 percent of water operations in the first ten-year period, but will then level off with no increase or decrease forecast for the second ten-year period.

Land

The FAA forecast calls for an increase of 89.3 percent increase in this activity for the ten-year period. This is not expected to be reached at Vancouver since, as the total amount of traffic at Vancouver increases, this type of traffic will likely go to other airports in the vicinity to avoid delays. In addition the higher monthly parking charges at Vancouver encourage aircraft owners to go elsewhere.

The first ten-year period forecast for pleasure flying is expected to be an increase of 80 percent. The second ten-year forecast is for a 75 percent increase.

TRAINING OPERATIONS

Training operations declined at Vancouver in the early 60s when training schools were forced by the Department to move elsewhere. However, in the last year three new schools have been allowed to commence operations and this is tending to increase the local training operations once more.

The forecasts were made on the basis that training would be allowed to continue at Vancouver International.

Water

Little water training is apparently carried out at Vancouver, however a 66 percent increase was forecast for the first ten-years and no increase for the second ten years. This would still make it a minor factor in water operations.

Land

Land training at Vancouver is expected to grow appreciably since it has been allowed to resume operations. It has been forecast to increase by 115 percent for the first ten-year period and by 100 percent for the second period.

The forecast increases for each segment of general aviation operations were used to obtain a total forecast figure for arrivals during a period in 1977 and 1987 which would be equivalent to that of the survey period. The figures show an overall increase for 1977 of 68% and for 1987 an additional 60%.

The following table shows the relative percentages of general aviation and scheduled traffic at Vancouver for the years listed.

VANCOUVER INTERNATIONAL

<u>Year</u>	<u>Type of Traffic</u>	<u>Percentage</u>
1966	Scheduled Movements 28,000	22%
	General Aviation Movements 98,549	78%
1967	Scheduled Movements 32,000	20%
	General Aviation Movements 133,000	80%
1977 (68% inc.)	Scheduled Movements 54,700	19%
	Gen. Aviation Movements 224,000	81%
1987 (60% inc.)	Scheduled Movements 84,900	19%
	Gen. Aviation Movements 358,000	81%

Using (1) Scheduled Movements From MPS Forecasts
(2) General Aviation Movements From ORD
Survey Forecasts

TABLE 8

It will be seen that general aviation will have a slight increase in its already large proportion of traffic at Vancouver Airport.

The relationship of the Vancouver airport general aviation movements to the area general aviation movements was studied. In 1966, Vancouver airport accounted for 18.8% of the general aviation movements in the Vancouver area.

When the forecast for 1977 of Vancouver area movements using the SRI method (1,257,000), was compared with the general aviation movements forecast for Vancouver airport using the ORD survey data (224,000), it was found that Vancouver airport is expected to account for 18% of the area general aviation traffic in that year.

It should be noted that these figures are valid only if the present system of airports are used and no unusual external influences are present.

If another airport is added to the system, or a policy change is made to influence specific segments of traffic to leave Vancouver airport, it would be necessary to re-compute the forecasts.

VANCOUVER INTERNATIONAL AIRPORT

GENERAL AVIATION AREA

Most of the general aviation operators at Vancouver have a mixed land and water fleet of aircraft. It is therefore quite important to them to have their land and water operations as close together as possible. The location of the water operation therefore almost dictates the location of the land operation.

At Vancouver there are only two possible locations for water operations:

- (a) the present site on the Middle Arm of the Fraser River on the south side of Sea Island.
- (b) the North Arm of the Fraser River on the north side of Sea Island.

The Middle Arm is not extensively used by water traffic since it is restricted the east end by the Morey Channel Bridge and at the west end by sand bars which almost close off traffic at low tide.

The Middle Arm is quite wide and presents a minimum hazard to seaplane operations. It is presently used for seaplane operations and is well provided with docking, beaching and fuelling facilities.

The North Arm is presently used quite extensively by shipping and fishing craft and also for log boom movement and storage. A large proportion of the north side of Sea Island is presently under lease for log storage. The North Arm is narrower than the Middle Arm and with the larger amount of water traffic would be more hazardous for aircraft operations.

The present seaplane operations area would therefore be the obvious location for future seaplane operations.

The present general aviation land operation area is adjacent to the water area. This allows the operators, (who have a large capital investment at the site) to conduct their land and water operations from the same location.

With careful planning there is room for the required general aviation expansion at the present site. Roads and services are already available in the area. The present terminal buildings will be available for use as general aviation terminals for the forecasted itinerant traffic increase.

CONCLUSIONS

1. A study of general aviation operations at Vancouver does not accurately portray general aviation activity in the Vancouver area. The inter-relationship of the airports and the fact that aircraft operations are not restricted to any one airport but will use those which best meet their needs, dictates that a forecast of general aviation activity must be made on a regional basis.
2. The forecasted increase of 7% per annum for local movements and 10.7% per annum for itinerant movements, indicate that the total practical annual capacity of the Vancouver area airports will be reached in 1971. The general aviation airports at Pitt Meadows, Abbotsford and Langley are now achieving over 80% of their practical annual capacity and will reach capacity before Vancouver International. If the capacities at the general aviation airports are not increased the traffic will probably spill over to Vancouver International and bring it to capacity earlier. Even with further development of the area airports, another airport site will be required in the Vancouver area within 5-10 years.
3. The best site for a new airport development would appear to be the Boundary Bay site. Its merits are location, accessibility and ease of development.
4. In the past at Vancouver, as well as other main-line airports, general aviation has been merely tolerated and the main emphasis for development of facilities was directed toward the scheduled carriers. The basis for this attitude has been the mistaken impression that general aviation had a homogeneous identity of a pleasure nature and had no real requirement to be at a main-line airport. The general aviation survey conducted at Vancouver International Airport indicates that some segments of general aviation have a close relationship with scheduled carriers and provide a service to the public which the carriers are unable to perform. Other segments of general aviation such as training and pleasure flying have no real requirement to be at a busy scheduled airport and as the airport approaches capacity these segments should be encouraged to go to other area airports.
5. In the future, as in the past, general aviation aircraft will comprise the bulk of the movements at the Vancouver Airport. The relationship of the general aviation movements at Vancouver to the total area general aviation movements is not expected to change significantly.
6. The present general aviation area on the south side of Sea Island and the present seaplane operations area on the Middle Arm of the Fraser River appear to have the best potential for future fixed facility areas for general aviation.

RECOMMENDATIONS

1. In future general aviation studies, one of the initial determinations must be whether or not the study should be attempted on an area basis or solely at one airport.
2. Planning should commence almost immediately to provide additional capacity at present general aviation airports in the Vancouver area to cope with the forecasted traffic increase.
3. Serious consideration should be given to the procurement of the Boundary Bay airport site for a general aviation airport. If this site cannot be obtained, alternate sites should be examined for operation before 1975.
4. A policy should be formulated for area airports, to develop the philosophy of specialized airports for specific types of aircraft use. The policy would be designed to attract general aviation aircraft to area airports, segregate the aircraft and airports by the use to which the aircraft are put, and to provide alternate facilities for operations not necessary or compatible with mainline airport operations.
5. A policy is required on the use of mainline airports by general aviation aircraft. This would include types of aircraft by use which would be permitted, recognition of a requirement for specific types of use to be at the airport, provisions for access to main terminal buildings by charter/air taxi operators and terms of use, control of issuance of licences for types of operations not necessary at the airport, and provision of an adequate development area for general aviation operations which are necessarily at the airport.
6. The present terminal and general aviation area at Vancouver International Airport should be designated as the area for future development of general aviation facilities. Consideration should be given to the allocation of one of the present terminal buildings for future use as a general aviation terminal.
7. The land rental policy now followed by the department should be examined to determine if it does indeed cause difficulties to the operators in obtaining financing for new building construction.

APPENDIX "A"

METHODOLOGY FOR CONDUCTING A GENERAL AVIATION STUDY

OBJECTIVE

The objective of the general aviation study is to collect data and prepare forecasts on the amount and nature of general aviation activity at a given airport or in a given area for a given time period from which a programme may be developed to accommodate user needs in the future.

The term "general aviation" includes all civil flying except that performed by major scheduled air carriers operating large aircraft on scheduled service.

At some airports where military operations constitute a significant portion of the traffic it will be necessary to have a separate section for military movements.

General aviation activities should be divided into five major categories; charter operations, business flying (corporate, private or government), training or instructional flying, pleasure flying and aerial work (crop dusting, pipe-line patrol, timber cruising, etc.)

The various activity groupings are defined as follows:

1. Business flying is the use of personal, corporate or chartered aircraft either directly for some business purpose or as a substitute for air carrier transportation to or from a place where business will be transacted.
2. Charter operations include transportation of passengers and cargo for hire. Whether conducted on a schedule basis or as small group pro rata charters, these movements are essentially supplemental to air carrier operations. In the United States this grouping is usually referred to as air taxi.
3. Pleasure flying includes transportation in personally owned or rented aircraft for recreational purposes, such as air touring, and other vacation trips.
4. Training flying includes those flights whose primary purpose is instructional or practice and not transportation from place to place. This category constitutes primarily flights which are classified as local in tower counts.
5. Aerial Work consists primarily of nontransport operations and includes such activities as survey, search and rescue, police patrol, news coverage, aerial application, fire fighting, and supply to offshore and other remote locations.

TERMS OF REFERENCE FOR THE GENERAL
AVIATION STUDY

In connection with the airport master plan report and in accordance with the "Scope of Work to Develop a Master Plan Report," conduct a study to determine the following.

1. Present and anticipated aircraft mix for general aviation.
2. Present and potential general aviation activity.
3. The effect on airport concepts of new or existing airports in the vicinity.
4. The future plans and requirements of general aviation operators at this site, or whether they intend or would prefer to move to a satellite airport. Costs, type of operations, availability of satellite or potential satellite sites, and operators' preferences must all be considered.
5. Utilizing forecasts and optimum layout, indicate recommended areas for general aviation ground installation.

METHOD OF STUDY

Data on general aviation for the airport should be gathered. At this point it should be determined if the airport should be considered as a single site or if there are other airports which serve the area. If there are other airports, the over-all area should be studied with special emphasis on the airport for which the master plan is being prepared.

Statistics required are:

1. General aviation movements for each airport broken down into local and itinerant for the past 5 - 10 years. (ATC Reports).
2. Number of aircraft based in the area. (A private aircraft which rents a parking space by the month or more would be considered to be based at the airport)(Regional Office).
3. Number of large aircraft charter flights conducted at the airports. (Aviation Statistics Centre).
4. Economic factors for area forecast. (Taxation Statistics).

If there is more than one airport in the area a forecast should be made for the total general aviation movements in the entire area.

Visits should be made to each of the airports in the area to become familiar with the types of activity at the airport, the surrounding terrain, the runway layouts etc. Discussions should be held with the airport managers and operations personnel at each airport. Much useful information can be obtained regarding peculiarities of the type of operations being conducted at the airport and specific problems which are encountered.

Demographic forecasts and land development plans should be obtained from area planning boards where possible.

FORECAST OF AREA GENERAL AVIATION ACTIVITY

The Stanford Research Institute has developed a mathematical model to forecast traffic on an area basis.

The model was developed on the premise that general aviation activity is a large non-homogeneous class of aircraft operations which are not restricted to any one airport in the area but will use those which best meet their particular requirements. Therefore, forecasting should be done on a regional basis where all interrelated airports near a metropolitan complex are included. Separate forecasts should also be made of the different segments of the general aviation population.

THE STANFORD RESEARCH INSTITUTE METHOD

A summary of the Stanford Research Institutes' "Recommended Method for Forecasting Non-carrier Activity" from their report - "Methodology and Criteria for National Airport Planning" is given below. In this method historical economic growth and general aviation growth over a ten year period are related by a "K" factor which is then used to relate general aviation growth in the future to predicted economic growth.

The economic growth of the area is assessed by considering the trends in such factors as, population, employment categories and their related income levels, and total area income. In the forecasting of non-carrier traffic or aircraft movements it is considered essential that any employment and income forecasts developed apply to the appropriate airport planning area - the metropolitan area.

GENERAL

1. An entire metropolitan complex should be treated as a single planning area.
2. A ten year growth period is recommended.

METHOD

1. Collect historical data for each type of non-carrier activity.
2. Calculate the historical growth factor (T_f)

$$T_f = \frac{T_2}{T_1}$$

3. Collect historical employment and income data.
4. Calculate the economic growth factor (I_f).

$$I_f = \frac{I_2}{I_1}$$

where

$$I_2 = \sum_{i=1}^n E_i (MI)_i = \text{total income in the planning area in a recent year.}$$

and

$$I_1 = \sum_{i=1}^n E_i (MI)_i = \text{total income in the planning area of, say, ten years ago.}$$

5. Calculate the "K" factor

$$K = \frac{T_f}{I_f}$$

6. If "K" factor differs greatly from Unity (1) other factors besides economic would have to be considered. This may be the case in pleasure itinerant and non-scheduled charter.
7. Project the economic figures.
8. Find the future economic growth factor I_f

$$I_f = \frac{I_2}{I_1}$$

where I_2 = projected total income in the last year of the growth period (i.e. 10th year)

I_1 = projected total income in a base year (i.e. present year)

9. Find the growth factor T_f

$$T_f = I_f K$$

10. Calculate the projected activity for the type of non-carrier operation chosen T_2

$$T_2 = T_1 T_f$$

where

- n is the number of employment categories used in analyzing the business and industrial activity in the planning area.
- E_i is the projected number of employees in the i^{th} area employment category in a specified future year.
- $(MI)_i$ is the median income per employee in the i^{th} area employment category in a specified future year.
- I_2 is the total income in the planning area in a specified future year.
- I_1 is the total income in the planning area in a specified base year.
- I_f is the growth factor, or ratio of area income in the specified future year to area income in the specified base year.

and where

- T_2 is the volume of traffic handled by the given type of noncarrier aircraft activity in the area in a specified future year.

or

- T_2 is the number of noncarrier aircraft operations of a given type in the area in a specified future year.
- T_1 is the level of a given type of noncarrier activity (traffic or number of aircraft operations) in the area in a specified base year.
- T_f is the growth factor, or ratio of the level of a given type of noncarrier activity in the area in the specified future year to the level of that activity in the specified base year.
- K is a factor that takes into account the change in a given type of noncarrier activity attributed to influences other than change in area employment and income per se.

LIMITATIONS OF S.R.I. FORECAST

The S.R.I. forecast is a regional forecast and hence nothing can be said about individual airports using this method. Short term changes in activity generated by changes in policy cannot be forecast accurately by this method or any other, except one which is based on ad hoc estimates based on experience. As was pointed out, the greatest limitation is the lack of historical data. Neither the necessary economic data nor general aviation by type data are available for Canada.

ADVANTAGES OF S.R.I. FORECAST

Being a regional forecast the S.R.I. method uses a broader base than a single airport forecast would. Since the forecast is based on economic factors, long term results of the forecast would tend to be more accurate than a forecast based only the previous growth of aviation. The S.R.I. method does meet the two specifications mentioned above -- segmented forecasting and forecasting by area. Lastly it is a method that can be easily repeated to improve forecasts as new information becomes available.

MODIFICATIONS TO S.R.I. METHOD

It may be necessary to modify the S.R.I. method since the proper data may not be available. Economic forecasts for a specific area may be lacking and it will likely be necessary to carry out an analysis of available historical data to determine the most suitable and to develop a projection from this data.

Usually the only available historical aircraft movement information is only broken down into local and itinerant movements. Forecasts should be made on these segments to determine the total general aviation movements for the area if no other differentiation by type is possible. A ten-year projection is probably the maximum that can be used.

APPLICATION

When a ten-year forecast for general aviation has been prepared it may be related to forecast scheduled movements to determine the relative percentages for the future.

A theoretical annual capacity for each airport in the area will be used to determine when the airport system will reach capacity from the forecast traffic.

Much useful information on population and planning for the area can be obtained from the local planning authorities.

SPECIFIC SITES

Each segment of general aviation could have a growth rate which is different from the other segments. These growth rates will also differ from airport to airport depending on the peculiarities existing at each airport.

Since little or no historical statistics are available on general aviation by type of use to which the aircraft are put, it is recommended that a survey be made at the airport under study to obtain the required information.

This survey should be carried out over a seven-day period during a reasonably high traffic month. This is necessary so that a large number of samples can be obtained. For the same reason the daily survey hours should be set to include as much traffic as possible.

Survey personnel should be placed at the various places on the airport where general aviation aircraft usually congregate. The pilots of each arriving aircraft should be requested to supply answers to the questions listed in the questionnaire shown as Annex I to this Appendix. Each arriving general aviation aircraft should be surveyed even if some aircraft are surveyed several times a day. This is to ensure that the survey can be related to the tower records and that the proper relationship for the total movements of each segment is maintained.

Each airport in the area should be requested to provide traffic movement figures for each day during the survey period.

The local Customs Office should be asked to provide the number of non-scheduled aircraft requiring inbound customs clearances during the survey.

The survey should be analyzed to provide at least the following general aviation information:

- (a) daily arrivals by type of use
- (b) the percentage of total arrivals surveyed compared to tower records of arrivals
- (c) relative percentages of the totals in each category
- (d) the number of pilots instrument rated

- (e) the number of aircraft IFR equipped.
- (f) the relative percentages of the various reasons for using the airport.
- (g) the number of aircraft requiring customs, (if a customs port of entry)

At each airport there may be additional significant information which should be gathered from the survey figures.

The large aircraft charter flights should be analyzed to determine their numbers and particular requirements.

An interview should be held with the general aviation aircraft operators based at the airport who will be asked to complete the questionnaire shown as Annex 2 to this appendix. In many cases the operator will not have firm figures available and his best estimate will have to be used. Some information is available from the operators regular reports to the ATB which can be obtained from the Aviation Statistics Center.

The information obtained from these interviews and questionnaires is to be organized and presented so that it will give as complete a picture as possible of general aviation activities and problems at the airport.

FORECASTS AT SPECIFIC SITES

1. For an accurate forecast of total general aviation activity at an airport it is recommended that each use category be forecast separately. Since it is unlikely that each use category will change at the same rate at all airports, no general increases or decreases from country-wide forecasts can be used without adjustment for the peculiarities of the local area.
2. Economic forecasts and, in the absence of other pertinent forecasts, the FAA report "General Aviation, A Study and Forecast of the Fleet and its Use in 1975" may be used as a guide to calculate future trends.
3. The forecast for the specific airport should be compared to the area forecast to determine the relative trends and to identify future problem areas.
4. The forecast should also be used to identify the approximate date at which airport capacity will be reached and to provide an indication of the types and amounts of traffic that might be moved to another airport in the area to prevent capacity being reached.

GENERAL AVIATION AREAS

If a general aviation area already exists at the airport, it should be studied to determine whether or not it is in the best location and whether it can accomodate the development required in the future.

GENERAL AVIATION SURVEY - AIRCRAFT MOVEMENTSSITE _____ DATE _____ WEATHER ^{VFR} _____
IFR _____

TIME _____ AIRCRAFT REGISTRATION _____

1. WHAT TYPE OF AIRCRAFT IS THIS? _____
2. HOW MANY PASSENGER SEATS DOES IT HAVE? _____
3. HOW MANY PASSENGERS DID YOU HAVE? _____
4. IS THE AIRCRAFT IFR EQUIPPED? Yes _____ No _____
5. DOES THE PILOT HAVE AN INSTRUMENT RATING? Yes _____ No _____
6. WHERE IS THE AIRCRAFT'S HOME BASE? _____
7. WHERE DID THIS FLIGHT ORIGINATE? _____
8. WHAT WAS THE REASON FOR THIS FLIGHT?
 - (a) Business (1) Corporate _____ (c) Training _____
 - (2) Private _____ (d) Aerial Work _____
 - (3) Government _____ (e) Charter _____
 - (b) Pleasure _____ (f) Test Flight _____
 - (g) Other _____
9. WHY DID YOU CHOOSE THIS AIRPORT?
 - (a) Close to town _____
 - (b) Meet scheduled airline _____
 - (c) Aircraft refueling or servicing _____
 - (d) Weather _____
 - (e) Home Base _____
 - (f) Other _____
10. DO YOU REQUIRE CUSTOMS? Yes _____ No _____

GENERAL AVIATION SURVEY
OPERATORS QUESTIONNAIRE

ANNEX 2

COMPANY NAME _____

1. How long has your operation been at _____ Airport?
2. What classes of operation do you conduct?
 - (a) _____
 - (b) IFR _____ VFR _____
3. What numbers and types of aircraft does your organization operate from this base?

<u>Type of Aircraft</u>	<u>Wheels</u>	<u>Floats</u>	<u>Amph.</u>
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

4. What is your area of operations (percentage)?
 - 0 - 100 miles _____
 - 100 - 500 miles _____
 - Over 500 miles _____
5. Are all your aircraft based at _____?
6. How many pilots did you employ full time?
 - Last Year _____
 - Five Years Ago _____
 - Ten Years Ago _____
7. What was your total number of fulltime employees?
 - Last year _____
 - Five Years ago _____
 - Ten Years ago _____
8. (a) Last Year
No. of Passengers _____ (b) Total Annual hours _____

9. Is your present area adequate?

Size _____

Location _____

Facilities _____

Outside Tie-Down Space _____

Comments

10. What do you anticipate your requirements will be in five years?

Area - Size _____

Location _____

Facilities _____

Outside Tie-Down Space _____

Personnel - Total _____

Pilots _____

Aircraft

Comments

11. What aircraft do you have on order?

12. Would you rather move to another airport?

13. Where does most of your business originate?

14. Where and how do you obtain Weather information?

15. Where and how do you Flight Plan?

APPENDIX "B"

AIRPORT CAPACITY ANALYSIS

VANCOUVER AREA

AIRPORT CAPACITY ANALYSIS - VANCOUVER AREA

VANCOUVER INTERNATIONAL AIRPORT

A. RUNWAY UTILIZATION (1)

<u>Runway</u>	<u>Total Movements</u>	<u>Percentage Used</u>
08	42,528	47.9
12	4,128	4.6
26	41,973	47.1
30	<u>230</u>	<u>.3</u>
	88,859	100.0%
Water	15,165	14.8% (2)

(1) Only itinerant aircraft movements as registered in 1966 were considered.

(2) Water itinerant traffic as a percentage of total itinerant.

B. AIRCRAFT POPULATION - (Classified by Performance)

Class A. All jet aircraft normally requiring runway lengths exceeding 6,000' for takeoff and/or landing (length corrected to sea level).

Class B.

- (a) Piston and turboprop aircraft having a normal weight in excess of 36,000 lbs.
- (b) Jet aircraft not included in Class A but having a normal weight in excess of 25,000 lbs.

Class C.

- (a) Piston and turboprop aircraft having a normal weight more than 8,000 lbs. and less than 36,000 lbs.
- (b) Jet aircraft having a normal loaded weight more than 8,000 lbs. but less than 25,000 lbs.

Class D. All light twin-engine piston and turboprop aircraft having a normal loaded weight less than 8,000 lbs. and some high performance single-engine light aircraft (Bonanza).

Class E. All single-engine aircraft other than those in Class D.

VFR MIX (Based on 29 June-4 July Survey.)

Class A. 10%

Class B. 25%

Class C. 10%

Class D. 15%

Class E. 40%

Only itinerant aircraft were considered. No local movements were included since, at present, these operate in Vancouver only when itinerant traffic conditions allow. Most of the local movements at Vancouver are flown by A and B type aircraft i.e. Canadian Pacific Air Lines and Pacific Western Airlines engaged in crew training. This occurs normally in off-peak evening or morning hours.

IFR MIX

Class A. $10 \times 1^* = 10 \times 2.02 = 20.2 = 20\%$

Class B. $25 \times 1^* = 25 \times 2.02 = 50.5 = 50\%$

Class C. $10 \times 0.7^* = 7 \times 2.02 = 14.2 = 15\%$

Class D. $15 \times 0.25^* = 3.5 \times 2.02 = 7.07 = 5\%$

Class E. $40 \times 0.1^* = 4 \times 2.02 = 8.08 = 10\%$

*Airborne Instruments Laboratory
conversion factor.

2.02 = Multiplication factor to
reconvert to 100% = $\frac{100}{49.5}$

C. PRACTICAL ANNUAL CAPACITY

The practical annual capacity of the Vancouver International Airport was calculated using a method devised by the Airborne Instruments Laboratory (AIL), a Division of Cutler-Hammer Inc. Practical Annual Capacity is defined as the number of aircraft movements handled annually at an airport where approximately 10% of the operations occurring during peak hours are in excess of the practical hourly capacity. It has been found that when annual demand exceeds the Practical Annual Capacity so determined, congestion and long delays are a common occurrence.

The Practical Annual Capacity of Vancouver International Airport, land side only, was calculated to be

238,400 movements/year

The variables required for the calculations of this capacity included the following

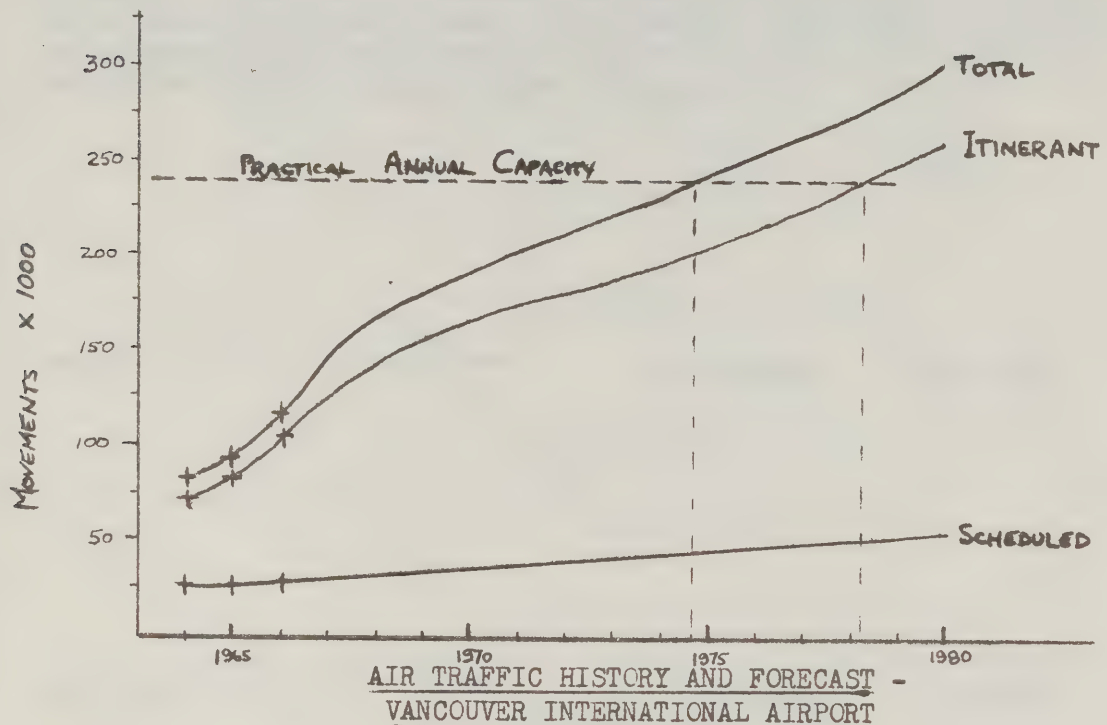
1. Aircraft population the present percentage population as determined in July 67 survey.
2. The Runway/taxiway configuration no changes were made from the present configuration.
3. Runway utilization it was assumed that the percentage utilization would remain basically as it is at present.
4. Weather weather was assumed 80% VFR, 20% IFR.

Further analysis made subsequent to the above calculations show that on the average 88% VFR, 12% IFR conditions prevail. Practical Capacity values may therefore be slightly pessimistic.

5. Hourly capacities as determined in the following section.

D. ANNUAL MOVEMENTS vs PRACTICAL ANNUAL CAPACITY

During 1966 a total of 117,508 movements were recorded by the land side of Vancouver International Airport. Of these 88,859 were itinerant movements.



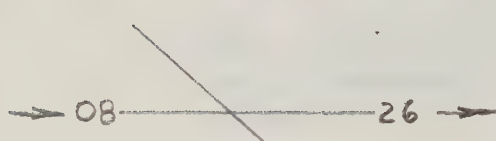
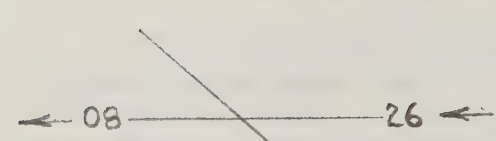
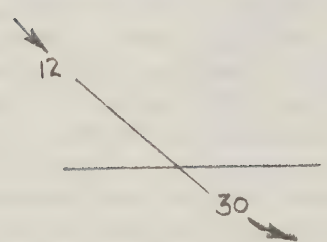
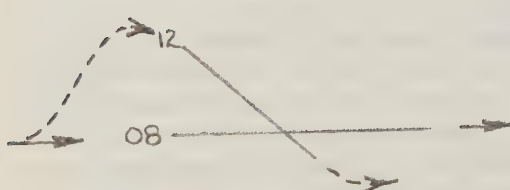
Using the Forecast of Annual Aircraft Movements as prepared in the Master Plans Section of CRP, it was determined that the airport in its present configuration would reach capacity in

- (1) 1974 if total aircraft movements (excluding water) are considered, or
- (2) 1978 if civil itinerant movements alone are considered. (Airline scheduled movements are included in this total.)

It must be remembered that the forecast growth was predicated upon an orderly, controlled growth at Vancouver International Airport. If the growth of general aviation in the area continues unabated and rapidly overflows the capacity of the present surrounding satellite airports, then the growth at Vancouver International itself could be accelerated and its capacity reached at an earlier date.

E. PRACTICAL HOURLY CAPACITY

AIL procedures were used to calculate the Practical Hourly Capacity; that hourly movement that can be sustained over a two-hour period by a given runway configuration, during which the average delay encountered by departing aircraft is four minutes under IFR conditions and two minutes under VFR conditions.

	<u>VFR</u>	<u>IFR</u>
	54 moves/hr	36 moves/hr
	53 moves/hr	36 moves/hr
	53 moves/hr	33 moves/hr
	58 moves/hr	40 moves/hr

The above capacities were calculated using the following variable parameters

1. Aircraft population was determined using data obtained during the June-July 67 survey.
2. Runway and taxiway configurations were unchanged from the present layout. Aircraft movements on the ground, however, were based on the premise that the airline passenger terminal is located in its "new" position.
3. Ratio of landings to takeoffs were assumed to be 1. (Measured 1.1 to 0.95 during June 67 survey.)
4. Capacity values quoted are those calculated values of aircraft movements which would encounter, on an average, four minutes delay in departure. Arrival capacity was not found to be a problem.

The VFR and IFR capacities are given for each runway configuration used more than 1% of the time. The VFR hourly capacity of the runway configurations used more than 90% of the time is 53 movements per hour. On occasion, itinerant movement rates have been recorded by the tower which have exceeded this calculated capacity. For example, from the Monthly Report of Aircraft Movements, January 1966, 54 and 52 itinerant movements were recorded during a consecutive 2-hour period. This is, however, misleading for aircraft movements flown by float-equipped aircraft operating from the Middle Arm of the Fraser River immediately adjacent to the airport, were included in these hourly totals. Only a detailed study of the January tower logs, which were unfortunately not available during the study, would tell exactly how many of these movements are water movements. Nevertheless, it was considered important to remove the influence of water traffic from these totals. Therefore, alternative methods were considered.

Examination and analysis of the July 1967 survey data plus the monthly movement reports for other years showed that approximately 17% of total itinerant movements were produced by the water side of the airport's operation. Water-to-land movement ratios were thus calculated for each month of the year and applied to the total itinerant movement values recorded in the monthly reports. Using this calculated ratio, we find, for example, that the peak itinerant movements as recorded in January 1966 are reduced to 48 and 46 movements.

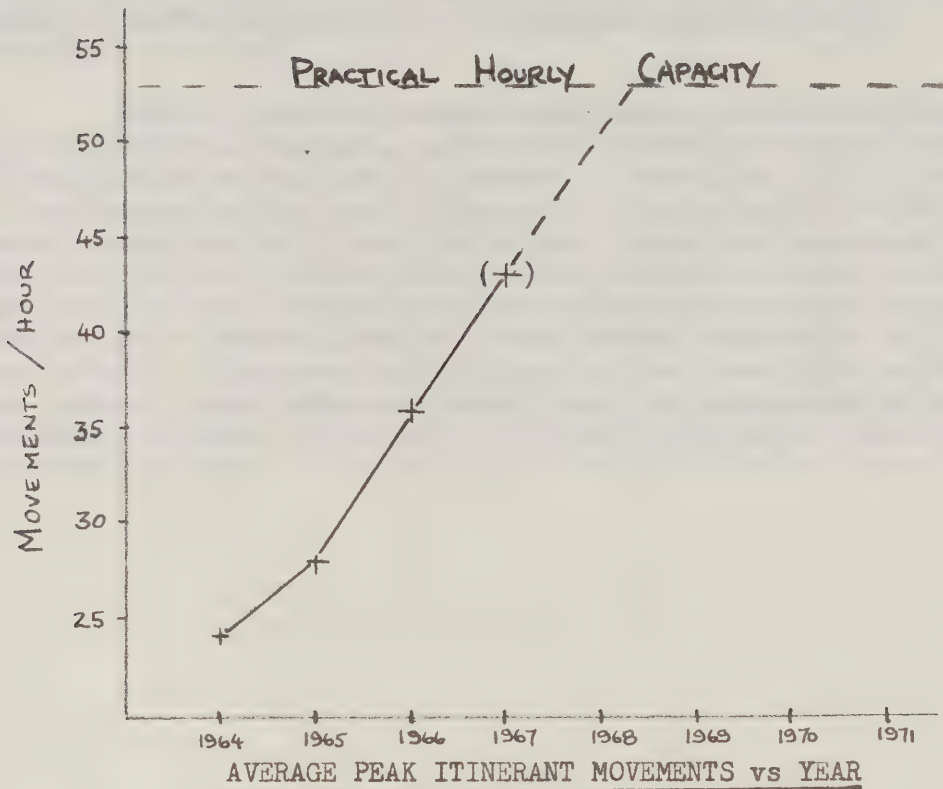
However, even these values are not too useful. Further examination showed that both of these values were in reality "isolated" peaks and therefore were not really indicative of the "average peak hour movements". It was considered necessary to provide some smoothing to the data to remove the somewhat false impression that these isolated peaks might give. The rationale used to arrive at this decision was that expensive facilities such as runways are not constructed to meet the demand of a few "isolated" peaks.

We are not alone in wishing to reduce the effect that isolated peaks can have on facilities planning. Municipal planners have used for some time "smoothed data" when determining requirements for new expressways. This procedure is now gathering favour in airport planning circles. Several methods of smoothing are available. The Dutch, at Schiphol Airport, chose those movement rates measured during the top 20 hours of operation of a given year and then calculate a weighted average based upon these figures. However, the method selected by ORD is one that appears to be used more frequently by a variety of airport planners (i.e. International Civil Airport Association, Paris Airport Authority). Aircraft movements recorded during either the top thirty (30) or forty (40) hours of the year are removed from consideration. The peak remaining is assumed then to be the "average" peak hour for the year. We have selected the top 30 hours, having determined that the value produced by this consideration differs only very slightly from that arrived at by considering the 40th hour.

How important is the removal of such peaks? Vancouver International Airport has a significant number of aircraft movements recorded during 18 hours a day, 365 days a year. Thirty hours is less than 0.4% of this total operating time. In 1966 the movements recorded during these hours (above that level finally determined as the "average peak") constituted less than 0.1% of the total itinerant operations. On the other hand the reduction of the "isolated" peak, 48, to the "average" peak, 36, is substantial (i.e. 25% reduction).

Itinerant movements for the years 1964, 1965, 1966 and some of 1967 were examined and 30 isolated peak values removed from each. The remaining totals were further reduced by removing the contribution associated with water operations at Vancouver. The "average" peak hours so determined were

79% increase	1964	24 movements/hour) 16.7% increase
	1965	28 movements/hour	
	1966	36 movements/hour) 28.6% increase
	1967	43 movements/hour, (based upon incomplete data)	



If the growth rate of the "average" peak remains substantially as it is at present, then the capacity of the airport during peak hours would be exceeded during 1969.

There is some doubt, however, that this growth of the average peak hour will continue at its present rate.

It has been noted in the United States, for example, that at airports operating near or at capacity, as the measured peaks

approached the calculated capacity the rate of growth of the peaks decreased. It was found that itinerant aircraft, whose arrivals and departures were more flexible than those of the scheduled airlines, chose to avoid the peak hours when the delays they would encounter would be substantially greater than those encountered during off peak hours. It should be noted that it is not possible to accurately forecast the point in time when the growth rate of the peak hour will change. Nevertheless, the net effect of this change in growth rate will be to delay the date when hourly capacity is reached.

Another important aspect whose effect was not considered in preparing this forecast, is that which results from the present ATC definition of the term "itinerant". During the July 67 survey it was discovered that many "itinerant" flights could, in fact, be better classified as "(local) itinerant" since they operated only from the Vancouver Airport during their complete flight. Approximately 1/3 of the flights classified itinerant during the survey were in fact "extended locals". When serious congestion is finally experienced at Vancouver International Airport, we might expect that some of these "extended locals" would be encouraged to operate elsewhere, provided of course that suitable alternate facilities are made available.

ABBOTSFORD

A. Runway Utilization

Based upon data obtained from the monthly reports on aircraft movements at Abbotsford for the year 1966 and confirmed during the July 1967 survey, runway utilization for Abbotsford is

<u>Runway</u>	<u>Percentage</u>
06	38.6
12	0.01
18	16.2
24	38.1
30	0.01
36	<u>6.6</u>
	99.52

B. Aircraft Population

The "Monthly Report on Aircraft Movements" for February 1967 was used to determine the mix of aircraft using Abbotsford Airport.

<u>Class</u>	<u>VFR</u>	<u>IFR</u>
A	5%	20%
B	5	20
C	5	15
D	10	10
E	75	30

Because it was not directly obtainable from the report of aircraft movements, the IFR population was extrapolated from the VFR population using a method devised by AIL.

C. Practical Annual Capacity

FAA/AIL methods were used to determine the Practical Annual Capacity of the existing runway/taxiway configuration. It was calculated to be

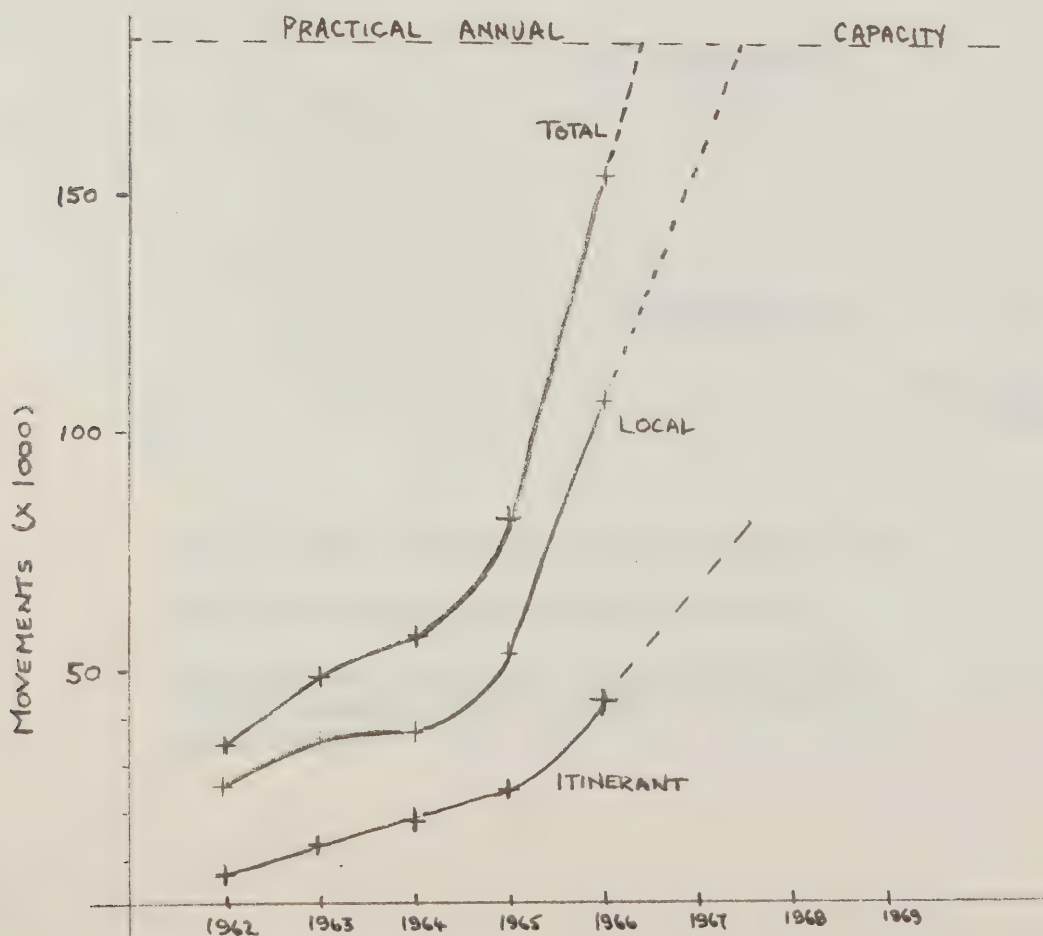
183,750 movements/year

Factors influencing the calculations of this capacity were



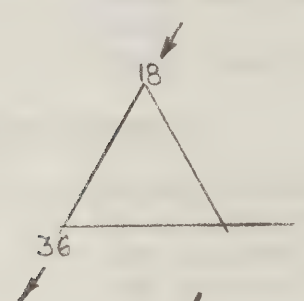
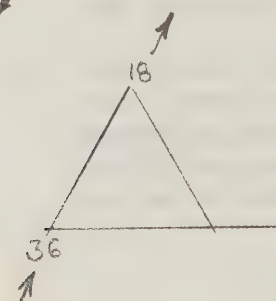
1. Aircraft population as shown above.
2. Runway/taxiway configuration as it is at present.
3. Runway utilization as determined by the 1966 survey.
4. Weather 11% IFR, 89% VFR
Similar to that shown for Pitt Meadows.
5. Hourly Capacities as determined in Section E.

D. Annual Movements vs Practical Annual Capacity

In 1966, 154,392 movements were registered at the airport. This value represents 84% of the calculated annual capacity and is an increase of 91.4% over the total movements of 1965. If the rate of growth recorded in 1966 were to continue, Abbotsford could reach theoretical capacity during 1967. It should be noted, however, that the growth in local training movements contributed most heavily to the startling increase in total movements in 1966. This segment of total traffic is most sensitive to local conditions and it is considered unlikely that it will maintain its spectacular growth.



E. Practical Hourly Capacity

	<u>VFR</u>	<u>IFR</u>
	115 movements/hr	48 movements/hr
	120 movements/hr	48 movements/hr
	117 movements/hr	*
	117 movements/hr	*

*runway not equipped
for IFR operation

Factors which influenced the calculations were

1. Aircraft population as shown in Section B.
2. Touch and Go operations. In 1966, 70% of the total operations were the result of touch and go movements.

PITT MEADOWS

A. Runway Utilization

In May 1967 a DOT tower commenced operations at Pitt Meadows. At the time of this report the May tower logs were the only records available for analysis. The sample therefore, upon which serious analysis could be attempted, was necessarily small. Nevertheless, indications from the incomplete data of previous years lead us to believe that it is representative.

<u>Runway</u>	<u>Movements</u>	<u>Percentage</u>
07	2542	38.6
18	512	7.75
25	3260	49.5
36	282	4.25
Total Land Itinerant Movements	6596	
Water	<u>135</u>	
Total Itinerant Movements	6731	

Further Comments

1. During the wet season, runway 18-36 is closed. Thus, activities are confined to a single runway. (During 1966-7, runway 18-36 was NOTAM'ed "Closed" from October through May.)
2. During the period September 59 to August 60, a wind survey was carried out in the vicinity of the present airport. During daylight hours when VFR conditions prevailed, the wind conditions favoured the use of runways

07	-	22%
25	-	21%
18	-	12%
36	-	30%
Calm	-	15%
		<u>100%</u>

B. Aircraft Population

The VFR itinerant aircraft population as determined by analysis of the May 1967 "Monthly Report on Aircraft Movements" is

Class D - 3.86%

Class E - 96.14%

During May, 2% of total itinerant movements operated from the water area directly adjacent to runway 07-25. The aircraft mix for this portion of the traffic was

Class D - 1.5%

Class E - 98.5%

Since Pitt Meadows is licenced for VFR operations only, there is no IFR traffic.

C. Practical Annual Capacity

The FAA/AIL method was used to determine the Practical Annual Capacity of the existing runway configuration. This was calculated to be

178,000 movements

Important factors which influenced the calculations of this capacity were as follows

1. Aircraft population assumed to be 5% D 95% E.
2. Runway/taxiway configuration assumed to be as it is at present.
3. Runway utilization assumed that 07-25 is used 90% of the time.
4. Weather Based on data obtained during a Sept.59-Oct.60 survey, the general weather conditions for Pitt Meadows were assumed to be

11% IFR, 89% VFR

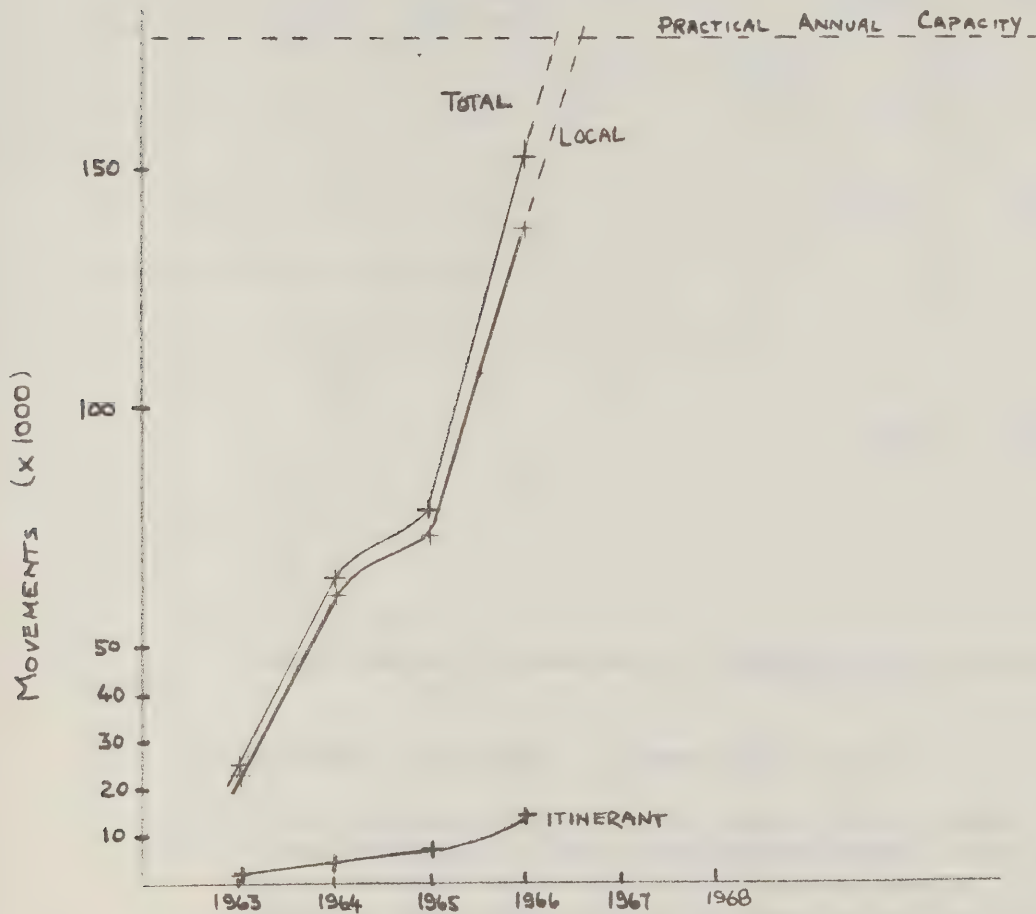
Weather conditions occurring during daylight hours only were considered.

The period September through January produced most of the IFR weather.

5. Practical Hourly Capacity as determined in the following section.



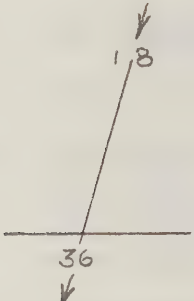
D. Annual Movements vs Practical Annual Capacity

During 1966 a total of 153,455 movements were recorded at Pitt Meadows. This is an increase of 93% over that recorded during 1965.



If the present rate of growth continues, Pitt Meadows will reach its Practical Annual Capacity during the present year 1967.

E. Practical Hourly Capacity

	<u>Utilization</u>	<u>VFR</u>
	49.5%	120 moves/hr (136)
	38.6%	123 moves/hr (139)
	7.75%	117 moves/hr (133)

were Factors which influenced the calculations of these capacities

1. Aircraft population assumed 5% D 95% E
2. Touch and Go operations were assumed to be 60% of the total movements. This value was determined from Tower logs obtained during the July 67 survey period. Yearly averages would suggest that values approaching 90% would be more realistic. The capacity values shown in brackets reflect this increase. FAA/AIL procedures were used to calculate the practical hourly capacities for those runways used more than 5% of the time. It will be noted that for over 87% of the time the capacity of airport is approximately 121 movements per hour.
3. Exit ratings of the various runways were calculated using present conditions.

F. Measured Peak Hour Movements vs Capacity

During May 1967 the tower recorded one 3-hour period during which movement rates of over 120 movements were recorded (120, 157, 133). On two other occasions in the month, movement rates of 121 and 123 were recorded. If such movement rates turn out to be the rule rather than the exception, then it is clear that Pitt Meadows is at capacity with respect to its present runway configuration.

G. Practical Annual Capacity (1970)

During 1968, construction will begin on a new parallel runway in the 07-25 direction and on a connecting taxiway. Capacity calculations were made using this new configuration.

In 1970 when construction is expected to be complete, the practical annual capacity will be

340,000 movements

The assumptions made, pertinent to the calculations were

1. Population 5% D 95% E
2. Touch and Go operations 90% of total movements.
This value is indicative of the percentage of touch and go observed. It was assumed that this rate would continue.
3. Runway/taxiway configuration
 - present runways plus a 2500' runway parallel to present 07-25.
 - paved taxiway to both parallel runways.
 - paved taxiway from hangar area to taxiway of new 07L-25R.
4. Runway utilization
 - 07R-25L is to be used for most itinerant movements.
 - 07L-25R is to be used for most Touch and Go operations.
 - If runway 18-36 is used only when strong cross-wind conditions exist on the parallels, it will increase the annual capacity of the airport by 5%.

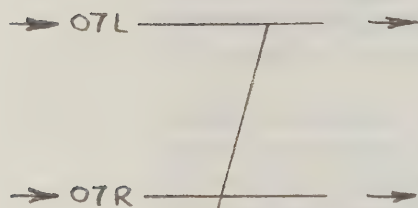
5. Weather

- as per original calculations.

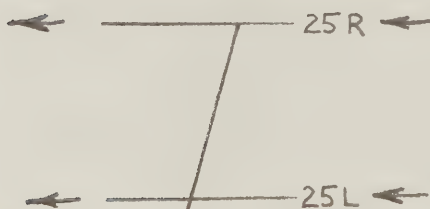
If the growth of total movements continues at its present rate, capacity of the new configuration would be reached in 1971. It is expected, however, that after the spectacular growth of the past two years this rate will decrease and approach that forecast for the Vancouver area.

H. Practical Hourly Capacity 1970

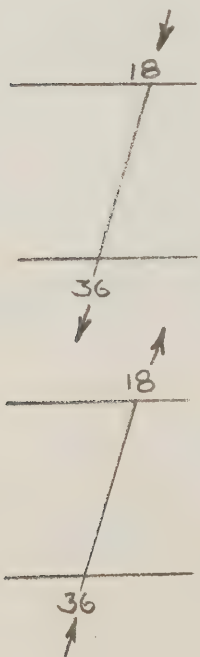
VFR



224 movements/hr



271 movements/hr



138 movements/hr

138 movements/hr

Factors which influenced the calculations of these capacities were

1. Aircraft population 5% D 95% E
2. Touch and Go Operations 65% of total operations.
With the opening of a tower at Pitt Meadows in May 1967, the activity counts show a reduction in "local" operations and an increase in "itinerant". It is possible that this change is a result of a more stringent adherence to ATC's definition of the term "itinerant" by the tower operators.
3. Exit Ratings The runways under consideration were assigned exit rating values which denoted a most favourable exiting condition. Since poor exiting reduces the capacity of a runway, it is assumed that any unsatisfactory exiting conditions which exist at present would be improved.
4. Runway Crossing Problems Problems associated with the interruption of landing traffic on 07R-25L by aircraft taxiing across this runway, were considered in the calculations.

LANGLEY, B. C.

The airport at Langley, B. C. is operated by the Corporation of the Township of Langley under a public licence. No formal movement statistics are kept, thus only estimates can be made as to its actual level of operation.

A. Runway Utilization

There are two runways shown on the latest aerodrome plate. Runway 07-25 is known to be grass/gravel surfaced and has one designated exit. During the July 1967 survey it was noted runway 01-19 was grass covered, however, it was understood at that time that this runway was to be paved; work to commence August 1967. Exits are planned for both ends of the paved strip.

During the July survey it was observed that runway 19 was used most frequently. Conversations with the airport manager confirmed that this runway was preferred whenever wind conditions allowed.

Grass areas outside the runways markers are known to be unserviceable during the wet season (October to May approximately).

B. Aircraft Population

Based upon incomplete observations made during the July 1967 survey, the aircraft population at Langley, for the purposes of these calculations, was assumed to be

100% E

No light twin-engine or high performance single-engine (i.e. Beech Bonanza) aircraft were seen to operate at the field during the visit.

Langley is not licenced for IFR flight.

C. Practical Annual Capacity

The FAA/AIL method was used to estimate the Practical Annual Capacity of the existing runway configuration. This was calculated to be

165,000 movements per year

Some of the factors which influenced the analysis were

1. Aircraft population it was assumed that it would remain as it is at present - 100%.E

2. Runway/taxiway configuration it was assumed that runway 01-19 was paved and that exits were available at each end of this runway.
3. Runway utilization without corroborating data it was necessary to assume that the situation at Langley would be similar to that of Pitt Meadows and that the paved runway, 01-19, would be used 95% of the time. The airport manager reported, during the July 1967 survey, that winds were frequently calm at Langley allowing the frequent use of runway 19.
4. Weather since formal records were not available for Langley, it was assumed that the weather data for Pitt Meadows would be representative of that for Langley.

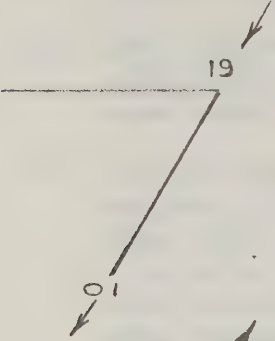
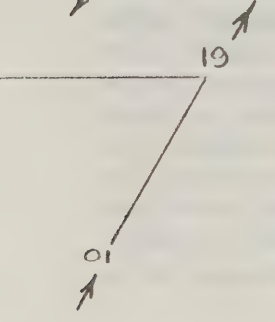
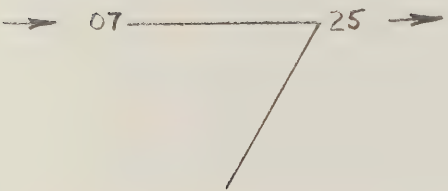
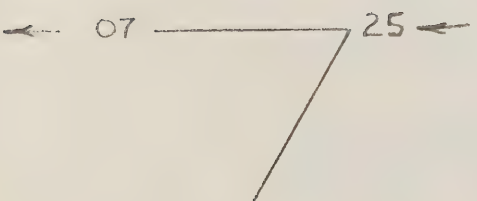
i.e. 11% IFR 89% VFR

D. Annual Movements vs Practical Annual Capacity

There are no recorded movement statistics available for Langley; only estimates were available from the airport management. They have estimated that approximately 120,000 movements occurred at Langley during 1966. This value would represent 75% of its calculated theoretical capacity.

It was considered that no meaningful projection could be made from the sparse data available.

E. Practical Hourly Capacity

	<u>Utilization</u>	<u>VFR</u>
	60%*	117 movements/hr
	30%*	117 movements/hr
	5%*	117 movements/hr
	5%*	90 movements/hr

*assumed

Factors which influenced the calculations of these capacities were

1. Aircraft population 100% E
2. Touch and Go operations. It was conservatively estimated that 60% of the total operations were local touch and go.
3. It was assumed that aircraft operations would be confined to designated runway and taxiway areas. Under ideal operating conditions, aircraft may be able to quickly clear the runways onto the grass areas adjacent to the landing strip. This would suggest that the runway had the best possible exit rating. If such were the case, hourly and annual capacities would exceed those values reported above. However, the grass areas bordering the runways are unserviceable for a large portion of the year (during the rainy season). Therefore the more pessimistic but realistic case, aircraft clearing only at designed exits, was assumed for this analysis.

BOUNDARY BAY

For a number of years the military airport at Boundary Bay has been closed to all aircraft traffic. Since there is now reason to believe that it may be reopened for use by civilian aircraft, it was considered desirable that an estimate of the capacity of this airfield be available for future planning use.

A. Runway Utilization

There are no recent runway utilization statistics available from either civilian or D.N.D. sources. It was necessary, therefore, to estimate the runway usage. We have based our estimates upon an analysis of some wind rose data that is reported to be representative of the surrounding area. This analysis suggested that, for a large percentage of the time (approximately 75%), runways pointing in a NE direction will be used, i.e. 01 and 07. In order to complete the picture, however, various other combinations were analyzed.

B. Aircraft Population

Since there are no actual aircraft movement records to analyze we have assumed that this airport would be used, if acquired, as a general aviation/business itinerant air field. The aircraft mix for the purposes of the analysis was assumed to be

0% A	0% B	5% C	25% D	70% E
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C. Practical Annual Capacity

The FAA/AIL method was used to calculate the annual capacity of the existing runway configuration. This was estimated to be

200,000 movements per year

Important factors which influenced the calculation of this capacity were as follows

1. Aircraft population as assumed above.

It should be noted that the hourly capacity of the airport (and thus indirectly the practical annual capacity) is quite sensitive to changes in aircraft population.

2. Runway/taxiway configuration

- All runways and taxiways shown on the latest available plans of the airport were considered serviceable.

3. Runway Utilization

- The combined use of 01 L and R for itinerant and Touch and Go traffic respectively, was given heaviest weighting in the analysis.

4. Weather

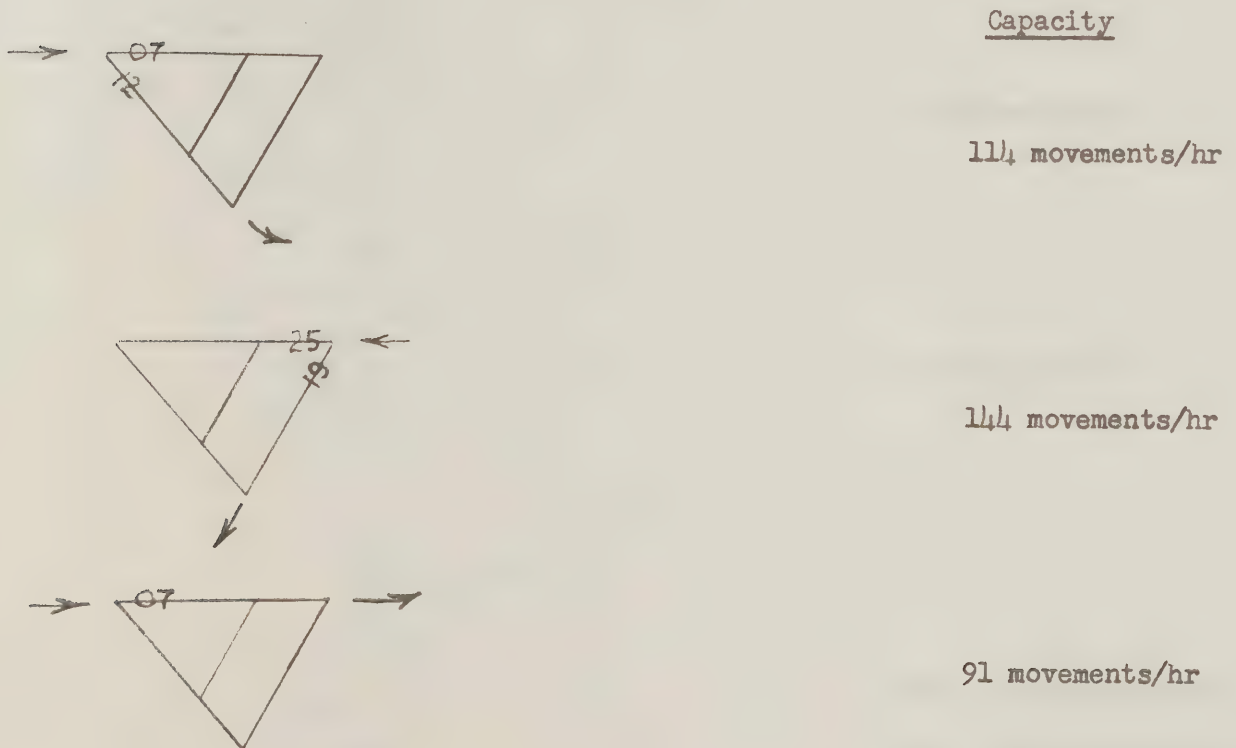
- It was assumed that it would be similar to Vancouver International. Incomplete MET reports do seem to indicate, however, that Boundary Bay enjoys a greater overall percentage of VFR weather than does Sea Island.

5. Hourly Capacities

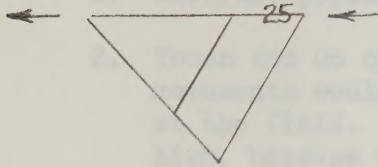
- as shown in Section D.

D. Practical Hourly Capacity

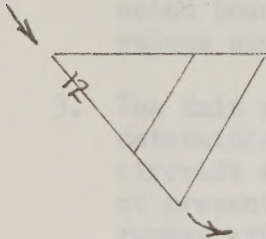
The Practical Hourly Capacities were determined using FAA/AIL procedures.



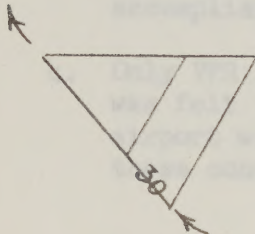
Capacity



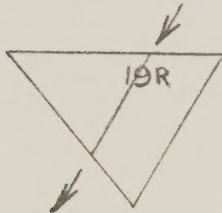
114 movements/hr



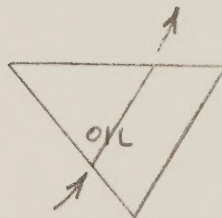
94 movements/hr



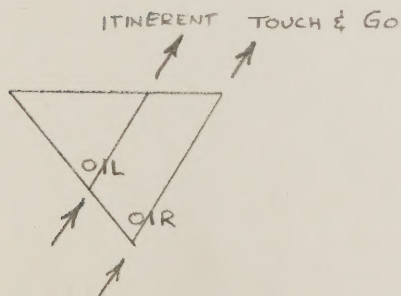
94 movements/hr



98 movements/hr



98 movements/hr



01R = 156 movements/hr T & G

01L = 134 movements/hr Itiner

